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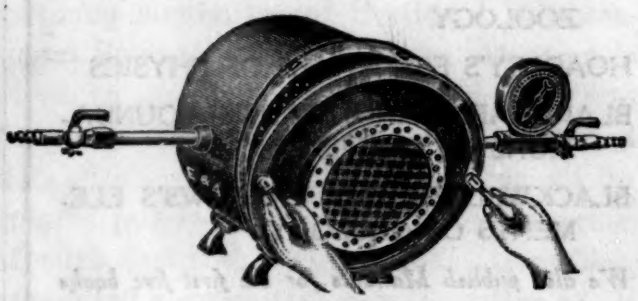

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POPULAR SCIENCE LECTURES[1]

INTRODUCTION

AT the meeting of the council in June, 1916, representations were made by the organizing committee of Section L (Educational Science) that much less attention is given to popular lecturing now than was formerly the case; and it was suggested that efforts should be made to promote increased public interest in science by means of such lectures. The council, therefore, appointed a committee representative of all the sections of the association to institute inquiries into this subject and prepare a report upon it. Many local scientific societies, universities, university colleges and similar institutions have organized popular science lectures; and the committee has endeavored to secure the results of the experience obtained, with the object of discovering the elements of success or failure.

A schedule of twelve questions was drawn up and was widely distributed. To prevent misunderstanding, it was pointed out in an explanatory letter that the committee was concerned only with single pioneer lectures for the general public, and not with students' courses, such as are arranged by university extension authorities, the Workers' Educational Association and other organizations.

[1] Report of the Committee of the British Association for the Advancement of Science consisting of the president and general officers, Professor H. E. Armstrong, Professor W. A. Bone, Sir Edward Brabrook, Professor S. J. Chapman, Professor A. Dendy, Professor R. A. Gregory (hon. sec.), Professor W. D. Halliburton, Dr. H. S. Hele-Shaw, Professor F. Keeble, Mr. G. W. Lamplugh and Dr. E. J. Russell, appointed by the council to consider and report on the popularization of science through public lectures.

A circular containing the schedule of questions was addressed to (1) principals and registrars of all universities (except Oxford and Cambridge) and university colleges in the United Kingdom; (2) principals, or directors, of all technical colleges represented in the Association of Technical Institutions; (3) secretaries of every university extension delegacy or board, of the Workers' Educational Association, the Gilchrist Trust and like organizations; (4) secretaries of all corresponding societies and of forty other local scientific societies; (5) curators of the chief provincial museums; (6) a few individuals having special knowledge of the subject.

By the middle of August, about 150 circulars had been returned, nearly all of them containing replies to the questions and also many valuable comments. The whole of these replies—about 1,500 in all—have been classified, and a digest of their substance is here given. The first question asked for the name of the society or institution providing the information.

ABSTRACT OF REPLIES TO QUESTIONS

2. *Are arrangements made for the delivery of public lectures upon scientific subjects each session? If so, (a) are the lectures free? (b) What are the lowest and highest charges for admission?*

In most cases local scientific societies arrange for the delivery of occasional popular lectures each session. These lectures, however, are not usually intended for the general public, but for members of the societies and any friends who may accompany them. The lectures are thus more of the nature of scientific meetings than public assemblies, and the fee for admission to them is the membership subscription, which varies from 1 s. to a guinea per session. In a few cases one or more public lectures are arranged each session, and admission to these is free, or at nominal charges varying from 1 d. to 6 d.

Series of public lectures are arranged by several corporations in connection with museums, libraries and other institutions, as well as by universities and technical colleges. The annual series of corporation free lectures at Liverpool includes scientific subjects; at the Horniman Museum, Forest Hill, S.E., twenty free lectures are given on Saturday afternoons from October to March; at the Manchester Museum, sixteen public lectures are arranged each year; at the National Museum of Wales, Cardiff, lectures are given from time to time in connection with special exhibits in the museum; at the Technical School, Barrow-in-Furness, a course of popular lectures is delivered on Saturday evenings; and at the museum, free library and Bentlif Art Gallery, Maidstone, free popular lectures were successfully arranged every winter before the war. The secretary of the Buchan Club, Aberdeen, remarks of public lectures:

> They were formerly given until they declined for want of suitable lecturers and variety of lectures.

And the principal of Battersea Polytechnic says:

> We have discontinued the arrangement of popular lectures as the attendance was discouraging. We have found that the people in this district will not attend popular lectures, whatever the subject. We have offered lectures by such men as Max O'Rell, E. T. Reed, T. Foster Fraser, T. P. O'Connor, Sir J. D. Maclure, F. Villiers, Fred Enoch and H. Furniss; and the response of the public was disappointing, although the charge for admission was only 3 d. We arranged for a lecture on "Air-ships" in the spring of this year, but failed to secure an audience and had to cancel the lecture.

3. *Where are the lectures usually given? (a) What is approximately the average attendance?*

Lectures given in rooms of museums,

public libraries, universities, technical schools and like institutions, attended by members of scientific societies and their friends, have usually audiences of about 30 in number, and the limit of accommodation does not often exceed about 200. The average attendance of the whole of the lectures, of which particulars have been received, is about 300. In the town hall, Stockport, the average is 1,250, "but this is a decreasing number;" at the Mechanics' Institution, Burnley, it is 800–1,200; at the town hall, Portsmouth, 500–2,000; at the Merchant Venturers' Technical College, Bristol, 600–800; at the Birmingham and Midland Institute, 700; at the Albert Institute, Dundee, 500–800; at various towns distributed through England, Wales and Ireland the average attendance at Gilchrist Lectures is about 600; and at the Geographical Institute, Newcastle, about 500.

4. *What subjects attract the largest audiences?*

From the point of view of local scientific societies, the most popular subjects are local archeology and antiquities, animal and bird life, and other aspects of natural history. The most popular public lectures are those on travel and adventure by explorers whose names are widely known. Astronomy is rarely mentioned, but this is probably because local scientific societies are mostly concerned with natural history and there are few good lecturers on astronomy. Science lectures must be illustrated by lantern slides or experiments if they are to appeal to a large public, and their titles should arrest attention. The chief point, however, is that lectures should deal with recent discoveries or topics which have been mentioned frequently in the daily newspapers. The largest audiences are usually attracted not by descriptive lectures on such subjects as mimicry, the descent of man, prehistoric animals, trade processes, and so on, but by those which are concerned with questions of wide economic or sociological interest, such as industrial research in America, wireless telegraphy in war, the wages problem, munitions of war, etc. One correspondent says:

> Purely scientific lectures do not attract, however eminent the lecturer. The most attractive lectures are the least scientific.

5. *Do you attach as much importance to the lecturer as to the subject?*

As much, or more, importance is usually attached to the lecturer as to the subject. Most of the replies are in this sense, and the following are typical of them: "The society does not, but the audience does;" "In order to attract subscribers, the chief importance is attached to the personality and celebrity of the lecturer;" "The lecturer practically determines the audience;" "Undoubtedly, if the lecturer is well known;" "Yes, more, for popular lectures;" "More to the lecturer, if known: if not known, to the subject." The best combination is, of course, an attractive subject and a celebrated lecturer, and the public soon forms its own estimate of the two factors. "The subject attracts in the first instance, but a poor lecturer would not draw a second time."

> Under the conditions here [Forest Hill, S.E., Horniman Museum], where there is a large population to draw on, title and subject are probably more important than lecturer. Nevertheless, some lecturers are always fairly sure of a good audience, and a series which begins with lectures by relatively poor lecturers soon suffers a reduction in size of audiences.

In many cases the lectures are given by members of the staffs of local museums, universities, or other institutions, but this limitation of choice of lecturer and subject soon exhausts the public interested in them.

6. *Are lectures by strangers generally more or less successful than those by local lecturers?*

When the visitor is a celebrated lecturer,

it is natural that larger audiences should be secured than in the case of local lecturers. Probably strangers are not invited to lecture unless they have more than a local reputation, and this accounts for the general opinion that they are more successful as regards size of audience. Typical replies to this question are: "Lectures by strangers, especially when they are celebrities, are far more attractive;" "Yes, as they are usually well-advertised; otherwise, I doubt if the numbers would be increased;" "Except for lecturers of world-wide fame, we find the attendance about the same for local lecturers as for outside lecturers;" "A known name, local or otherwise, is generally more attractive than that of a completely unknown person;" "Strangers distinguished in literature, science or public life generally attract good audiences. In the case of scientific lectures, local lecturers appeal more to the general public owing to the fact that it is a difficult matter for an outside lecturer to provide adequate experiments. The majority of these lectures in the past have been delivered by our own staff" (University College, Nottingham). "It depends on the lecturer; when a local lecturer lectures repeatedly in the same district he ceases to draw really large audiences" (Manchester).

The general conclusion seems to be that for lectures to local societies, with audiences numbering from about 30 to 100, local lecturers "draw" as much as visiting lecturers of the same standing, but the visitor has to depend more upon the subject and title to attract an audience. "The fact that a prophet is not without honor save in his own country somewhat discounts the popularity of local lecturers; but a distinguished local man will attract a larger audience than a much less distinguished stranger" (Manchester).

7. *If fees are paid to lecturers, what is the usual amount for* (*a*) *Lectures with or without lantern slides,* (*b*) *Lectures with experimental illustrations?*

Few local societies have sufficient funds to pay lecturers: the result is that most scientific lectures arranged by these societies are given free or for out-of-pocket expenses. Members of the staffs of colleges and other institutions also usually give public lectures locally without fees. The general fee to professional lecturers, with lantern slides or experimental illustrations, or both, varies from three to ten guineas. Dr. Wertheimer, principal of the Merchant Venturers' College, Bristol, says, in answer to the question: "Varies with the lecturer. We have found some dear at five guineas and others cheap at fifteen guineas." The Stockport Science Lectures Committee usually pays ten guineas for a lecture, but in exceptional cases, as for Sir Ernest Shackleton and Sir H. B. Tree, forty guineas have been paid.

8. *With admission free, or at a nominal charge, and excluding the cost of the hire of a room or hall, what is the usual profit or loss upon a popular science lecture?* (*a*) *If there is a loss, how is it met?*

9. *Are any local funds available for people's lectures?*

As lectures to members of local scientific societies and their friends are usually given free, expenses are low and are met by the general funds of the societies. The secretary of the Buteshire Natural History Society says:

> Some years we have had lectures for the public for which a charge was made—about 6 d. There was usually a profit, after paying everything, of a few shillings.

There is, however, rarely a profit upon a public lecture. The Buchan Club, Aberdeen, estimates the loss at £1 to £2 per lecture, and it is paid from the funds of the society. Even with the well-arranged Gilchrist Lectures delivered in various parts

of the country, the average loss is about £10 a lecture and is met by a grant from the Gilchrist Trustees. At Stockport

the hall has been hired, with charges for admission. The greatest profit in the early years was approximately £20. In recent years there has been a loss. A number of local gentlemen guaranteed a guinea each in case of loss. No call has been made upon them.

At University College, Nottingham, the loss per lecture is from £2 to £5, but no allowance is made for the services of the lecturer and his assistant, or for the use of apparatus. In such cases the loss is met out of college funds. Lectures are likewise given in many places as part of the educational work of museums and the cost is paid out of the incomes of the institutions. When the museum is a municipal institution, or lectures are arranged by a Free Public Library Committee, any loss comes out of the rates. Thus the secretary of the Albert Institute, Dundee, says:

As the lectures are all delivered within the premises of the Free Library Committee, any charge for admission is prohibited by the Public Libraries Acts. The Albert Institute Lectures have proved so popular that they are regarded as a branch of the work of the Free Library Committee. A sum of about £25 is usually taken in the estimates of that committee for expenses—lantern operator, making slides, arranging halls, etc. All my lectures are gratuitous.

Similarly, the chief librarian of the Liverpool Public Libraries remarks:

The public libraries are rate-supported, and lectures are part of the public library work. This library was established by special Act of Parliament, and not under Ewart's Library Act. Authority was included in our Act to pay for lectures. The vote by our council for lectures during the past few years has been about £1,100 per year.

In other cases the cost of popular lectures is paid by the legal education committee or out of the grant made to the institution by the board of education.

Very few localities have special funds available for the expenses of public lectures. The secretary of the Kilmarnock Glenfield Ramblers' Society says, however: "The Kilmarnock Philosophical Society has considerable funds for providing lectures, but has not done so for many years." At Dundee,

the late Lord Armitstead gave, about twenty-five years ago, a sum to establish "The Armitstead Lectures." No local lecturers are engaged. A nominal charge for admission is made. These were formerly well attended, but latterly the attendance has fallen off. The Albert Institute Lectures now tax the full accommodation of the Albert Hall. They are absolutely free to the public.

There is at Perth a local trust fund, called the Duncan Bequest, for lectures; and at Maidstone the popular lectures are provided out of the Bentlif Wing Trust Fund of the museum, free library, and Bentlif Art Gallery. The Midland Institute, Birmingham, has a small endowment of about £30 a year for science lectures; and the Royal Technical College, Glasgow, has an endowment fund for popular lectures on astronomy. The Gilchrist Educational Trust is referred to in detail later. One of the purposes of the Chadwick Trust (40 Queen Anne Chambers, Westminster, S.W.) is to provide for "the delivery by competent persons of lectures on Sanitary Science," and a number of successful lectures have been given in pursuance of it, particularly during the war. Among the subjects of these recent lectures are: Racial Hygiene and the Wastage of War; War and Disease; Food in War-time; Typhus in Serbia; Prevention of Disease and Frostbite in the Army. The Trust pays all expenses of fees, hall, lantern, advertising and printing, though halls and lanterns are often lent.

10. *Has public interest in popular science lectures increased or decreased in your district during the past ten or twenty years?*

The analysis of replies to this question is

inconclusive. About one third of the correspondents report that interest has increased, another third that it has decreased, and the remaining third that it has remained stationary or no decided change has been noticed. Museums mostly report an increase of interest, and technical institutions a decrease. No general conclusion can be derived from the replies from scientific societies, in which so much depends upon the energy of the secretary and the constitution of the committee. For example, the Birmingham and Midland Institute Scientific Society reports an increase, while the Birmingham Natural History and Philosophical Society records a decrease.

As regards public interest in science lectures Dr. M. E. Sadler remarks: "I should say that it has increased and might be greatly stimulated by further efforts." Other replies to this effect are: "I do not believe that public interest in popular science lectures has decreased, but it certainly has less opportunities of manifesting itself" (School of Technology, Manchester). "There has been a marked increase of interest within the past five years" (University College, Aberystwyth); "In that time the public interest in our lectures has increased considerably" (Kilmarnock); "The interest in the Manchester Geographical Society's weekly lectures has greatly increased during the past fifteen years."

The chief causes of decrease of interest in many districts are indicated in the following replies: "The public interest has doubtless decreased slightly during the past ten years. This is to some extent accounted for by the fact that during recent years scholars from the secondary and other schools in the city have continued their education at the college and other institutions, attending two and three evenings per week, and therefore do not attend single lectures as in former years. The opening of picture-houses has probably also affected the attendance at lectures" (University College, Nottingham). "Decreased. The lectures are no longer novel, there is increasing difficulty in obtaining new and good lecturers, and there are many counter-attractions, *e. g.* kinema, other lectures in the same town, etc." (Stockport Science Lectures Committee). "Decreased: representatives on public bodies either have not the time (through commercial claims), or the interest, to devote any attention to the matter" (Chelmsford). "I should say decreased with the quality of the lecture. Good lectures are rare and generally well attended" (Plymouth).

The whole matter is admirably summed up by Mr. D. B. Morris, Town Clerk, Stirling, as follows:

> Comparing the position of matters now with that of thirty years ago, the popular lecture does not now occupy the place in public esteem which it did. For this there are various causes. With the better type of young persons, attendance at continuation classes, with their organized schemes of study, takes the place of attendance at popular lectures. To the non-studious the picture-house is the habitual place of resort. Many of the films there shown are such as would be exhibited at a popular science lecture.
>
> As regards older people, some find that life has to be lived more strenuously nowadays, and rest or quiet recreation are sought in the evening rather than anything distinctly intellectual. The great popular interest which used to be taken in natural history arising out of the "evolution" controversy, and inspired also by the writings of Darwin, Wallace, Huxley, Lubbock, Kingsley and others, has passed entirely away. Such interest now centers in subjects like wireless telegraphy, aviation, and, at present, all matters connected with the war.
>
> Serious students will always be found to attend courses where educational value is to be got, but popular lectures will not succeed unless illustrated by kinematograph, lantern, or experiments, or by all three. The element of entertainment must be present, which implies novelty. Arrangements might be made with local picture-houses to have a fortnightly or monthly scientific evening, which

would take the form of a popular lecture with illustrations. Tickets, containing a short syllabus of the series, could be sold at cheap prices, a local organization assuming financial responsibility.

11. *Can you suggest any course of action to follow in order to increase public interest in science in your district by means of popular lectures?*

The chief needs referred to are: (1) a supply of trained popular lecturers; (2) coordination of effort of educational institutions, university extension committees, municipal corporations, trades councils, and similar bodies; (3) adequate advertisement and interesting press notices; (4) lectures dealing more especially with subjects of present-day interest, or relating to the needs of the district; (5) endowment of popular science lecturers so as to enable lectures to be provided at a moderate cost; (6) the use of the kinematograph in science lectures.

Many correspondents seem to think that popular lectures are necessarily of the instructive kind and intended to induce people to take up courses of study at educational institutions. They have little faith in such a means of increasing the number of students, and rightly so. The purpose of public lectures may be, however, not so much to create desire to study as to enlighten the community upon the relation of science to individual and national life. The point of view is thus entirely different from that of the local educational institution or the local scientific society, both of which regard popular lectures as possible means of securing new students or members. The position is clearly stated by Principal Garnett, School of Technology, Manchester, in the following reply:

> A more general realization by competent lecturers of the benefits which popular lectures may confer upon the community and a greater readiness on the part of universities and colleges to spend money on the provision and advertisement of such lectures. At the present time eminent men of science are, with few (if any) exceptions, rendering in other ways more valuable national service than they could render by the delivery of popular lectures. Moreover, the restricted financial resources of governing bodies are probably more usefully employed in the conduct of research and in providing the education required by men who are to occupy responsible positions in the various industries. The financial difficulty would disappear if an inspiring account of the broad outlines of natural science formed part of the curriculum of every elementary and secondary school. This "science for all" is to be carefully distinguished from the science training given to those who are to pursue further the study of science in some institution of higher education or are to use it in their daily work.

Mr. R. J. Moss (Royal Dublin Society) says:

> Much more attention must be given to science in school education. It should be made interesting and taught as much as possible by demonstration and experiment. In this way the coming generation may be enabled to appreciate science and to take an interest in the progress of knowledge. A great deal of good might be done by the creation of traveling lectureships to be held for a limited time by men who show an aptitude for the work.

12. *What do you consider are the chief elements of success, or reasons for failure, of public lectures upon scientific subjects?*

Among the conditions of success mentioned in replies to this question are: (1) The reputation and personality of the lecturer, (2) effective advertisement and newspaper reports, (3) energy and efficiency of local secretaries and committees, (4) attractive titles, and choice of topical or popular subjects, (5) plenty of lantern slides, use of bioscope films, or good experimental illustrations. It is obvious that a lecturer should adapt himself to his audience, and should possess expository power, so as to deal with his subject in a clear and interesting manner, without degenerating into the style of a public entertainer.

Professor Herdman states the chief ele-

ment of success to be "a good lecturer who can be heard, has a definite story to tell, and can tell it in plain language." This is also the view of Principal Garnett, who says: "The chief elements of success seem to me to be that the lecturer should be vividly conscious of the closest relation that exists, or that can be established, between his subject and the daily lives of his audience; and that he should possess an expert knowledge of his subject, a power of lucid exposition, and a pleasant and forcible delivery."

The replies received show that these conditions are rare among lecturers; and failure is often ascribed to the absence of them. A subject and style appropriate to a lecture at the Royal Institution are unsuitable for a working-class audience such as that at the Royal Victoria Hall, though this is sometimes forgotten. The librarian and director of the Sunderland Public Libraries, Museum, and Art Gallery, remarks:

> The expertness of the lecturer and his constant association with experts often causes him to be ignorant of the ignorance of his audience. On the other hand, he is occasionally patronizing. In failing to approach his subject from their point of view he is occasionally "over their heads," and, despite his specialization, frequently fails where "a man of the people," or a non-expert, will succeed with less knowledge, but better judgment. There should be the same difference between a "popular lecture" and a scientific discourse, as between an interesting primer and an advanced scientific treatise in literature. The successful "popular" lecturer is, I think, more rare than the advanced or scientific lecturer. Failure may possibly be attributed to the growth of light-entertainment halls, or maybe to a wider and more popular treatment of subjects in the press. There is also a greater literature now, and a wider circulation of it through libraries.

Even in lectures to local scientific societies the subjects are frequently treated in too advanced a manner, and are therefore unintelligible to many of the audience. It is suggested by some correspondents that if more attention were given to science in schools there would be a larger attendance at popular lectures; but much depends upon the nature of the science teaching. The principal of the technical school, Barrow-in-Furness, writes:

> I am afraid that one of the causes lies in the dreary nature of the instruction in "science" given in the day-schools (secondary). No one here who has learned chemistry, for instance, in a day-school seems to wish to learn more.

The thirst for amusement and excitement, no doubt, accounts largely for want of interest in science by the great majority of the public. There are now so many counter-attractions, such as picture palaces, music-halls, and other places of entertainment, that the general public is attracted to them rather than to lectures which require mental effort to understand them.

> People want recreation after the day's work, and prefer amusement rather than instruction.

Experience shows that in an ordinary provincial town there is usually a small minority of intelligent persons who profit considerably from popular or semi-popular science lectures, but that the general community of the district is untouched by them.

> Such attempts as have been made to reach larger audiences, with a low standard of education, by means of ultrapopular lectures have proved failures (Gloucester).

In this, as in most cases, lectures of the instructive type are referred to, and not those which aim at the appreciation of science as a living force in social economics or state affairs. Mr. H. J. Lowe, secretary of the Torquay Natural History Society, remarks:

> The only way I can see to helping science into its proper position as an essential in national development is by the recognition and proclamation by the government and educational authorities of its immeasurable importance in attaining national efficiency. This should be followed by some general scientific knowledge being required in all pass-

ing examinations, as a guarantee of an acquaintance with science method and reasoning.

The provision now made for the study of scientific and technical subjects accounts, no doubt, for the failure of popular lectures in many districts. When there were few institutions of higher education, the thoughtful section of the population took advantage of such lectures to extend their knowledge, but now the same class is provided for in educational institutions and courses. The public science lectures of the present times, therefore, need not be of the same kind, or on the same subjects, as those of a past generation, but should be adapted to more modern needs and interests. Above all, they should be intended for the people as a whole, and not for students or others who propose to devote systematic attention to the subjects of the lectures or devote their careers to them. This distinction is not recognized in the subjoined remarks by Mr. C. F. Procter (Hon. Sec., Hull Scientific and Field Naturalists' Club), which represent the views of many scientific societies as to the present position, yet it is most important.

Mr. Procter says:

Scientific lectures can only be made popular in the sense that you attract the crowd of unscientific people, with a profusion of experiments, or, failing that, lantern illustrations. People will flock to the Egyptian Hall and are vastly entertained and educated a little by an exhibition of what is often clever scientific acrobatics. Human nature loves to see what it can not understand, and twenty years ago represents a period when the commonplaces of science were a wonderland to the average mind. The trend of education has altered that, and has sharply divided the same people into a minority of scientific enthusiasts who "ask for more," and a majority of indifferents who remain cold at a display of the old elementary stuff. Education (and that includes very largely the popular science lectures of the past) has created in this, as in all the arts, a small aristocracy of intellect, or, rather, comparatively small. These are not satisfied with anything that can possibly be popular. They are long past that, but will feverishly attend anything which proposes further to explore the deep water. The crowd—the man in the street and his womenkind—has had its wonder-bump excised in the school laboratory. Modern sensationalism in amusement and the plethora of scrappy yet crisp literature (which religiously exploits every new thing, scientific or otherwise, that may entertain) has calloused this excision. The application of the film-pictures to microscopy, etc., is about the only way to popularize science lectures, but—why bother? We can not all be men of science, and the present system provides that any who get the call may answer it, whilst popular lectures only attempt to entertain individuals of an age who are already past the slightest hope of ever being useful scientists. The proper thing is already being done by our schools, universities and university extension lecturers with our budding professors.

The following letter from the acting registrar of University College, Nottingham, bears upon some of the foregoing points:

Popular lectures have been delivered for the past thirty-five years at this college. During the past few years the numbers delivered on science subjects have been less than in previous years, but there is good reason to believe that if some pecuniary assistance from a central fund could be devoted to lectures on science much progress might be made, not only in this city but throughout the whole of the East Midland area. At one time it was the practise to arrange during each session two or three series of lectures on scientific subjects during the winter terms. These series consisted of three or four weekly lectures on each subject and were generally delivered by professors of the college. The professors received no extra remuneration for this work and as the ordinary college work grew it was almost impossible for the time to be spent in the preparation, which, it can be well understood, was very extensive. Ten to fifteen years back we always had crowded audiences, but these were cut down owing to the opening of so many picture-houses in the city and also to the fact that many of the senior scholars from the secondary and other schools now continue their education at the college and other institutions, attending two and three evenings per week.

CONSTRUCTIVE PROPOSALS

Many correspondents are of the opinion that the formation of a panel of lecturers

who would be prepared to assist small societies by lecturing for a small fee would be of great assistance. Mr. H. V. Thompson, Hon. Sec. of the North Staffordshire Field Club, says:

> It would greatly facilitate matters if the British Association prepared a list of lecturers on various scientific subjects who, although not necessarily in the first rank of scientific attainment, could be relied upon to give lectures which would hold and interest a normal popular audience. This course would much assist local clubs and societies in the difficult choice of lecturers and also enable them to gauge the interest in science in the district. Furthermore, promising young men would be introduced to districts where they are unknown at the present time.

Mr. H. E. Forrest, Hon. Sec. of the Caradoc and Severn Valley Field Club, makes much the same suggestion, as follows:

> I think local societies might help each other a great deal more than they do. In almost every society there are one or two members who are good lecturers on some particular branch of natural science. These might, in many instances, be willing to lecture to other societies for their expenses or a nominal fee. I suggest that you prepare a list of these gentlemen (giving addresses), with the subjects on which they lecture, and send the list to all corresponding societies, leaving it to their secretaries to make arrangements direct with the respective lecturers.

Mr. Herbert Bolton, curator of the Bristol Museum and Art Gallery, suggests that there should be an exchange system of lecturers among museum curators:

> If, say, a dozen curators had all to work up lectures upon subjects with which they are familiar, they could, by arrangement, deliver the lectures at eleven other places in addition to their own, and so put in a good winter's work and make a good lecture reach a wide audience.

Similar suggestions are made by several correspondents for the exchange of lecturers among local scientific societies.

SUMMARY

1. Many local societies arrange for the delivery of occasional popular or semi-popular science lectures, but the audiences are mostly made up of members and their friends.

2. In most places there is a small circle of people interested in scientific work and development, and sufficient means exist to enable them to extend their acquaintance with diverse branches of natural knowledge, but the great bulk of the community is outside this circle and is untouched by its influence.

3. Popular lectures on scientific subjects do not usually attract such large audiences as formerly in most parts of the kingdom. To make a wide appeal to the general public the same principles of organization, advertisement and selection of lecturer and subject must be followed, as are adopted by agents of other public performances.

4. Increase in the number of educational institutions has provided for the needs of most persons who wish to study science, either to gain knowledge or prepare for a career. Other people seek entertainment rather than mental effort in their leisure hours, and they require subjects of topical interest, or of social and political importance, to attract them to lectures.

5. Few popular lectures pay their expenses, and scarcely a single local society has a special fund upon which it can draw in order to meet the cost involved in the provision of a first-rate lecturer and adequate advertisement.

6. Expenses of public lectures are usually paid from (*a*) general funds of local societies; (*b*) college or museum funds; (*c*) rates; (*d*) education grants; or (*e*) Gilchrist and other trusts.

7. After the war there will be a new public for lectures and courses on a wide range of subjects; but one of the main purposes of the lectures should be to show as many people as possible that they are personally concerned as citizens with the posi-

tion of science in the state, in industry and in education.

RECOMMENDATIONS

1. That an annual list of public lecturers on science subjects be prepared and published, with titles of their lectures. No fees should be mentioned in the list, but addresses should be given so that committees organizing lectures may make their own arrangements with lecturers. Local scientific societies, museums and institutions of higher education should be invited to send the names of members of their bodies prepared to deliver lectures to similar bodies elsewhere without fee other than traveling expenses, and the names of such voluntary lecturers should be indicated in the list by a distinguishing mark.

2. That committees organizing public science lectures should include representatives of as many interests as possible, such as municipal corporations, trades councils, cooperative societies, religious bodies, university extension committees, chambers of commerce, educational institutions, local scientific societies and like organizations concerned with the daily work and intellectual life of the district.

3. That to extend interest in science, and belief in its influence, beyond the narrow circle of serious students, increased use of the bioscope in illustrating natural objects, scenes and phenomena is desirable; and an appeal should be made to the interests of all classes of the community by addresses intended to show the relation of science and scientific method to national life and modern development.

4. That to carry on the propaganda of efficiency through science, local committees should endeavor to secure financial support from manufacturers and others affected by national progress, and that local educational authorities be asked to provide funds to enable free popular lectures of a descriptive kind, for children as well as for adults, to be well-advertised and for reasonable fees to be paid for lecturers and their illustrations.

5. That more encouragement should be given at university institutions and training colleges to the art of exposition and public speaking, for the benefit of those students and teachers whose aptitudes may later be usefully exercised in promoting interest in science.

6. That while the training of an adequate number of scientific workers is of prime importance, it is desirable that everyone should be made acquainted with the broad outlines of natural science while at school, and that public appreciation of scientific knowledge as an essential factor of modern progress should afterwards be created and fostered by means of popular lectures.

7. That this report be brought under the notice of each section of the association with the object of obtaining suggestions upon which organized action may be taken in connection with the Gilchrist Trust or independently.

8. That the committee be reappointed as a committee of Section L, its constitution remaining, as at present, representative of all the sections of the association, but with power to add to its numbers.

THE FOURTEENTH NEW ENGLAND INTERCOLLEGIATE GEOLOGICAL EXCURSION

THE annual meeting of the geologists of the New England colleges and universities was held on Friday and Saturday, October 27–28, under the direction of Professors W. O. Crosby and C. H. Warren, of the Massachusetts Institute of Technology.

The purpose of the excursion was to study the batholithic cycle of the Blue Hills at Quincy, Massachusetts. Here the intricate

relations are well displayed, are not obscured by later dynamo-metamorphism, and have been determined with notable thoroughness and skill in independent and supplemental work by Crosby, Loughlin and Warren; Professor Crosby's results having been published in 1895, Loughlin's in 1911, and Warren's in 1913.

Preliminary explanations of the geology were given with the aid of lantern slides by Professors Crosby and Warren Friday evening, October 27, in the lecture room of the Boston Society of Natural History. The excursion, participated in by 39 persons, representing 12 institutions, left Boston at 8:49 A.M., October 28, and returned at 5:30 P.M. Superb weather, the beauty of the Blue Hills in autumnal foliage, the geological interest of the rock exposures, and the instructive interpretation of them by the leaders, combined to make memorable this excursion.

A synopsis of the geological relations of the Blue Hills complex as they were shown in the course of the day is as follows:

The invaded sediments are dark, uniform, siliceous argillites of Cambrian age. They were closely folded and were metamorphosed by the contact action of the underlying magma into hornstones. The structural relations show that they are remnants of a cover which before erosion extended over a considerable portion of the Quincy granite batholith. Some parts, now marginal, are preserved because they have been down-folded and down-faulted below the present level of erosion. Some isolated remnants indicate by their parallel orientation within the abyssal rocks that they were roof pendants, other outcrops show by their lack of orientation that they were marginal inclusions of greater or less size. These hornstones preserve within them diabase dikes, showing thus the nature of the advance intrusions from the magma which gave rise to the Quincy intrusions. The initial age of these dikes was clearly shown by their restriction to the sedimentary cover and one was pointed out which, furthermore, was cut by a thin dike of fine-grained granite. Next in the series to the diabase dikes is the conspicuous rhomben porphyry, the matrix of which is as dark as the diabase, but whose composition is in reality intermediate between that of the diabase and that of the granite. The series thus indicates a progressive differentiation, but discontinuous intrusion. The rhomben porphyry is associated with the margins of the sedimentary cover and is found also abundantly as angular blocks, cognate xenoliths, within the next marginal phase. During the process of crystallization of the rhomben porphyry there was repeated shattering and invasion by slightly different phases of the same magma. Finally the zone was shattered and invaded by a distinctly differentiated magma, the third of the series. This crystallized as a granite porphyry. It occurs in places in considerable mass, but elsewhere may exist as discontinuous fine-grained rims one or two inches thick about the xenolithic blocks of older phases. In places where a cracking but not disruption of the rhomben porphyry occurred there was some thin infiltration of the following magma accompanied by a metasomatic impregnation of the walls to a depth of a quarter to half inch, bringing about by recrystallization an approach to the nature of the later rock. One of the most interesting relations of the granite porphyry was seen in its chilled contacts with an aporhyolite. The latter appears to have formed a thin chilled cover to the batholith, made from the same magma, yet cut by the porphyritic phase. It indicates that the roof of older rocks had here been destroyed after the stage of the rhomben porphyry and that the batholith was in effect partly deroofed in this acidic stage. Following the granite porphyry came, after another interval permitting some slight further differentiation, the great upwelling of the Quincy granite. This, the main rock of the batholith, was followed later by the feeble injection of a few diabase dikes, closing the cycle. In the opinion of Professor Warren the structure of the roof of the batholith indicates invasion chiefly by stoping.

This small batholith is regarded as a local and structurally high intrusion belonging to the far wider and more complex batholith, which underlies much of New England, which

outcrops in many areas where erosion has worn through the ancient cover, and whose intrusive history covers a long period of time in the upper Paleozoic.

The age relations of the Quincy succession are limited by the facts that the igneous rock cuts the Cambrian sediments and is covered by Carboniferous conglomerates which rest upon the eroded surface of the porphyry. The age is regarded by the leaders as probably Devonian or Mississippian.

In the unavoidable absence of the permanent secretary, Professor Cleland, this record of the excursion is made at his request by the secretary *pro tem.*

JOSEPH BARRELL

YALE UNIVERSITY

CLEVELAND ABBE

IT fell to the lot of this modest man, a distinguished representative of American science, to initiate the national systems of weather forecasting which are to-day maintained by nearly every civilized nation of importance. With the science of meteorology Abbe's name will be associated through the coming ages.

With the death of Cleveland Abbe, chief meteorologist of the United States Weather Bureau, terminated the original phase of national meteorological work in America, for he was the sole surviving active official of the bureau in which he had served forty-six years.

As one of his associates, I accepted the invitation of SCIENCE to pay a tribute to his memory, which adheres to personal relations, and not to the evolution of that great idea which took possession of his soul in the small astronomical observatory in Cincinnati, an idea which was to blossom forth in practical form throughout the world.

When in 1870, at the invitation of Chief Signal Officer A. J. Myer, Abbe entered the signal office of the army to undertake the work of predicting the weather of the United States, he found his position and his duties most onerous and embarrassing. The environment was military, and the young officers had been drafted into scientific work that was tentative and unknown. Besides initiating a novel service Abbe was to cooperate with civilian scientists and to train in the new work officers fresh from the western frontier, from the military academy and from remote artillery seacoast stations. He entered on these manifold duties with the same equanimity and devotion as had marked his astronomical work in Russia and at home. The original scientific force engaged in weather and flood forecasts were nine in number. Besides the civilians, Abbe, T. B. Maury and William Ferrel, there were Chief Signal Officer A. J. Myer, Lieutenants R. Craig, H. H. C. Dunwoody, A. W. Greely, C. E. Kilbourne and J. P. Story. All are dead except Craig, Dunwoody and Greely, who are on the retired list of the army.

Through all the changes, from military to civic control, from one weather bureau chief to another, Abbe continued steadily at his scientific work under six separate administrative chiefs, active along lines of study and research to the last. It is interesting to note that the scientific bodies of the country have not contributed more than half a dozen officials of prominence to the bureau—though it has been under civil control 26 years—to the present force which has grown up under lines initiated by the practicality of Myer and the theories of Abbe.

During twenty years of his service I was intimately associated with Abbe as his subordinate and pupil, as a coworker, and as his administrative chief. During this term of years there inevitably developed situations which were complex, annoying and embarrassing to the scientific force. Yet in all such conditions I never knew him to display bad temper, to unduly prolong discussions, to advance personal interests, nor to abate his most strenuous efforts to carry out such policies as were judged needful for the good of the service—even though they had not originally met with his approval.

As a student in various subjects, such as light, heat, meteorology, etc., as a lieutenant I taxed for months his amiability and temper, for his very serious and methodical methods often excited my amusement and led to jocose

and sarcastic comments, which he always met with gentleness and sorrow.

His weather forecasts, from which he gained deserved fame, were always deduced by strictly considering the effects that should follow certain observed conditions. An amusing instance of that practise gained wide circulation among the office force. At 10 A.M. it suddenly began to rain in Washington, and at 10:15 A.M. Abbe predicted that there would be no rain in the city for the 24 hours beginning at 8 A.M. that day. When taxed with it he simply said: "There was nothing in the conditions shown by the map that scientifically indicated rain." He was equally true to his beliefs in all other directions. Fidelity and loyalty marked his long public career, and in Browning's words Cleveland Abbe could truthfully say that of his life, he "learned to love the true."

A. W. Greely

THE AMERICAN SOCIETY OF NATURALISTS

The American Society of Naturalists, in affiliation with the American Association of Anatomists, the American Society of Zoologists, and the Botanical Society of America, will hold its thirty-fourth annual meeting at New York, under the auspices of Columbia University, on Friday, December 29, 1916, and, by invitation of the Carnegie Station for Experimental Evolution, at Cold Spring Harbor on Saturday, December 30.

The Botanical Society of America will place the genetical papers of its program on Thursday morning December 28, and the American Society of Zoologists will group its genetical papers in a program for Thursday afternoon. By this arrangement there will be sessions of genetical interest on the day preceding the meetings of the Naturalists and continuing with the Naturalists' programs for Friday and Saturday.

The Friday morning session of the Naturalists will be open for papers on evolution, genetics, and related subjects from members or invited guests, titles of which with estimated length of delivery must be in the hands of the secretary by December 1. Requests for microscopes or for space for demonstrations should also be sent to the secretary.

The program of Friday afternoon will be a symposium on "Biology and National Existence," with papers by Stewart Paton, W. J. Spillman, V. L. Kellogg, Jacques Loeb and E. G. Conklin.

The annual dinner, in which members of the affiliated societies are invited to participate, will be held in the evening of Friday at the Hotel Manhattan, which has been selected as the headquarters of the Naturalists.

There will be a joint smoker for members of the Naturalists and of the affiliated societies at the Columbia University Commons, Wednesday evening, December 27.

Members of the American Society of Naturalists are invited by the Carnegie Station for Experimental Evolution to spend Saturday, December 30, at Cold Spring Harbor. A morning session from 10.30 to 1 will be held in Blackford Hall for the presentation of genetical papers. After a lunch there will be opportunity to inspect the equipment of the station, the activities of which will be explained by the staff. Arrangements for trains will be announced in the final program.

Bradley M. Davis,
Secretary

THE ENDOWMENT OF THE MEDICAL DEPARTMENT OF THE UNIVERSITY OF CHICAGO

The General Education Board and the Rockefeller Foundation have appropriated $2,000,000 (each $1,000,000) for the establishment of a medical department in the University of Chicago. It brings Mr. Rockefeller's contributions to the university up to nearly $37,000,000.

The university will set aside at least $2,000,000 for the same purpose, will give a site on the Midway valued at $500,000, and will raise a further sum of $3,300,000. The medical school will therefore start with an endowment of almost $8,000,000.

Rush Medical College, established seventy-five years ago, will go out of existence. The Presbyterian Hospital which Rush College

has used, will be taken over by the University of Chicago and will be reorganized to provide adequate clinical and laboratory facilities. A new laboratory building will be erected in immediate conjunction with the hospital. The buildings and grounds of the Presbyterian Hospital are valued at about $3,000,000.

A statement given out by Dr. Abraham Flexner says:

This project will be giving the city of Chicago a high-grade medical school and it will also provide for the first time in this country a post-graduate school adequately equipped and financed.

The school will be erected on the Midway Plaisance, and will thus form a part of the present University of Chicago plant. High-grade modern laboratory buildings will be provided for instruction in the students' first and second years, and a university hospital under complete control of the university, with laboratories and an out patient department, will be built on the Midway.

The entire teaching staff, clinical as well as laboratory, will be organized on the full time basis. That is, all the teachers for clinical as well as laboratory studies will give their entire time to teaching and research in the university hospital and medical school. Professors and their assistants will hold their posts on condition that they become salaried university officials and that they accept personally no fees whatever for any medical or surgical services.

The only medical schools in the country to-day which have embraced the full time teaching plan are Johns Hopkins Medical School and the medical department of Washington University, St. Louis.

The full-time scheme is a plan to insure to hospital work and medical teaching the undivided energy of eminent scientists whose efforts might otherwise be distracted by the conflicting demands of private practise and clinical teaching. The full time scheme is an appeal to scientific interests and devotion of the clinician, and the results so far realized through the plan at Johns Hopkins have been most satisfactory.

It should be of increasing consequence to the public that the training of those studying to become doctors should be in charge of the most competent men obtainable devoting their entire time to this work. Greatly increased efficiency and thoroughness should result, to the alleviation of suffering and the cure of disease.

The new institution thus to be established in Chicago will be equipped with every modern facility for medical instruction and with ample funds for operation.

SCIENTIFIC NOTES AND NEWS

THE American Academy of Arts and Sciences on November 15 presented the Rumford medals to Mr. Charles Greeley Abbot, of the Smithsonian Institution, for his researches on solar radiation.

DR. GEORGE F. KAY, head of the department of geology of the University of Iowa and state geologist of Iowa, has been elected university research lecturer for the current year. During each year the university lecturer visits the educational institutions of Iowa and delivers a lecture in which is involved the spirit of research. This policy has been followed successfully for about ten years.

DR. JOSEPH J. KINYOUN, bacteriologist of the health department of the District of Columbia, who, at the request of the authorities of Winston-Salem, N. C., has been for several months engaged in the reorganization of the health department of that city, has resumed his duties in Washington.

MAJOR-GENERAL GOETHALS, governor of the Panama Canal Zone, will pass into the retired list of the army on his own application dating from November 15, after forty years' service. The order of retirement affects only General Goethals's military status and does not operate to relieve him from duty as governor of the Canal Zone, but is preliminary to his retirement.

THE Sociedad Argentina de Ciencias Naturales, Buenos Aires, has elected as corresponding members Sir Ernest Shackleton and Mr. W. H. Hudson, the author of "Argentine Ornithology" and other works.

ON the occasion of his seventieth birthday on December 7, 1915, Professor A. Voss, of the University of Munich, received from the Munich technical high school the honorary degree of doctor of technical sciences.

AT the annual meeting of the British Astronomical Association on October 25, it was

stated that Major F. L. Grant, who had been severely wounded at the front, had resigned the secretaryship. Mr. W. Heath, M.A., was appointed to the vacancy.

Dr. J. L. E. Dreyer has resigned his office as director of the Armagh Observatory, a position which he has held since 1882.

In addition to the awards announced in April for papers read at the meetings, the council of the British Institution of Civil Engineers have made the following awards for papers published in the *Proceedings* without discussion during the session 1915–16: Telford Premiums to Messrs. Hubert Mawson (Liverpool), T. W. Keele (Sydney), R. W. Holmes (Wellington, N. Z.), W. Fairley (London), J. M. Greathead (Johannesburg), T. C. Hood (Manmad, India), and J. B. Ball (London); the Manby Premium to Mr. W. C. Cushing (Pittsburgh, U. S. A.), and the Crampton Prize to Major C. E. P. Sankey, D.S.O., R.E. (London). The Indian Premium for 1916 has been awarded to Sir John Benton, K.C.I.E. (Eastbourne).

Professor C. R. Orton, of Pennsylvania State College, is on leave of absence for one year and has registered for graduate work at Columbia University. He will spend some time at the New York Botanical Garden in connection with his researches on parasitic fungi.

The steam yacht *Alberta,* which is to carry a party of scientific men headed by Dr. Alexander Hamilton Rice up the Amazon River, left New York City, November 15, for South America. The expedition plans to make a topographical survey of portions of the Amazon valley and interior districts and studies of the diseases of natives in that section. The members of the party include, besides Dr. and Mrs. Rice, Dr. William T. Councilman, pathologist of Harvard University; Earl S. Church, of Newport, of the United States Coast and Geodetic Survey, and Ernest Howe, of Newport, geologist.

At the recent meeting of the Clinical Congress of Surgeons held in the various institutions in Philadelphia, Dr. John C. Clark, chief operating surgeon at the University Hospital and professor of gynecology at the University of Pennsylvania, was elected president. The next meeting of the congress will be held in New York City.

Dean Francis C. Shenehon, of the College of Engineering of the University of Minnesota, has been engaged as consulting engineer since the middle of June on hydraulic investigations in Illinois and will be absent from the university almost continuously until the middle of December.

Dr. Robert M. Lewis has left for Shanghai, China, where he will be associated with Dr. McCracken, teaching in the University of Pennsylvania Medical School of China, which a few years ago became a department of St. John's University. He goes as one of the representatives of the Christian Association of the University of Pennsylvania and expects to return some time in the spring. He has lately been associated with his uncle, Dr. Howard A. Kelly, in surgical work at the Johns Hopkins University.

Mr. Edwin T. Hodge, who has been pursuing graduate studies in geology at Columbia University for the past two years, and has spent one summer season in field investigation in Porto Rico, has been given a position on the instruction staff in the department of geology in the University of British Columbia.

The Harveian oration before the Royal College of Physicians of London was delivered by Sir Thomas Barlow on October 18.

The address of the retiring president at the anniversary meeting of the London Mathematical Society, on November 2, was delivered by Sir Joseph Larmor, who took as his subject "The Fourier Harmonic Analysis: its Practical Scope and its Limitations."

The Bradshaw lecture before the Royal College of Physicians of London was delivered on November 2 by Dr. Hector Mackenzie, whose subject was exophthalmic goitre. The Horace Dobell lecture was delivered on November 7 by Dr. H. R. Dean, on the mechanism of the serum reactions. Dr. W. H. R. Rivers has given a second course of FitzPatrick lectures

on medicine, magic and religion, on November 14 and 16.

ANOTHER course of Chadwick public lectures has been arranged. Professor Stirling gave the first of three lectures on fatigue and its effects on industry and efficiency, at the Royal Society of Arts, Adelphi, on October 27. Dr. Charles Porter began a course of three lectures on the health of the future citizen, at the Norwich Museum on November 2; Dr. J. C. Nash, county medical officer and chief school officer, Norfolk, will give a lecture on baby saving for the nation, at the Hampstead Central Library on November 20; and Mr. Paul Waterhouse will give the first of three lectures on architecture in relation to health and welfare, at the Surveyors' Institute, Westminster, on November 30.

THE birthplace of Weierstrass in Osterfelde in Westphalia has recently been marked by a memorial tablet.

THE death is announced of Arthur G. Smith, head of the department of mathematics and astronomy in the University of Iowa.

A. B. ALEXANDER, assistant in charge of the Bureau of Statistics of the United States Fisheries Commission at Washington, has died.

DR. JULIUS H. EICHBERG, professor of materia medica in the college of medicine, University of Cincinnati, died on October 31, 1916.

THE death is announced of Dr. Jean-Joseph Picot, formerly professor of clinical medicine at the Bordeaux School of Medicine, at the age of seventy-seven years, and of G. Salomon, professor of physiological chemistry at the University of Berlin, aged sixty-seven years.

MAURYCY RUDZKI, since 1902 director of the Cracow Observatory, has died at the age of fifty-four years.

AT the invitation of Dr. E. C. Pickering, the fourth annual meeting of the American Association of Variable Star Observers will be held at the Harvard College Observatory, on November 18, 1916.

IT is announced from Sweden, that no Nobel prizes for science or medicine will be awarded for this year, but that the money will be reserved for 1917. The money for the prizes for 1915 has also been reserved and will be added to the special fund.

WE learn from *Nature* that Professor A. S. Donner, director of the observatory at Helsingfors, has presented to the university, of which he was formerly rector, the sum of £8,000, to ensure the continuance, and indeed the completion, of the "Catalogue photographique du Ciel, Zone de Helsingfors," begun under his direction in 1890. Hitherto the work has been paid for, partly by the university, partly by Professor Donner out of his private means. The sum now allotted by him is intended to cover all expenses for twelve years, when, at its present rate of progress, the task should be finished.

UNIVERSITY AND EDUCATIONAL NEWS

AMHERST COLLEGE has received a gift of $100,000 from Mrs. Rufus Pratt Lincoln, of Plainfield, N. J., to establish a chair of science. Professor John M. Tyler, professor of biology in the college since 1879, has been elected the first Rufus Tyler Lincoln professor. Amherst College has also received a bequest of $5,000, to be known as the Edward Tuckerman Fund, for work in botany.

PROFESSOR WILLIAM ESSON, late Savillian professor of geometry at Oxford, by his will gives ultimately to Merton College and the University of Oxford his estate, the value of which is about $55,000.

DR. JOHN SHARSHALL GRASTY, formerly associate professor of geology at the University of Virginia, has resigned to take charge of the new department of mining geology recently established at Washington and Lee University. Dr. Albert William Giles has been appointed adjunct professor of geology in the University of Virginia.

THE *Bulletin* of the American Mathematical Society announces appointments of instructors in mathematics as follows: C. H. Clevenger in the school of mines of the University of Minnesota; C. N. Reynolds in Wesleyan University; P. R. Rider in Washington University;

J. J. Tanzola, of Columbia University, in the U. S. Naval Academy, and Dr. C. H. Forsyth, of the University of Michigan, in Dartmouth College.

Dr. Chas. H. Otis has resigned his position as instructor in botany and assistant botanist at New Hampshire College and Experiment Station, to accept a position in the biological laboratory at Western Reserve University. Dr. Otis will have charge of the instruction in botany in Adelbert College and the College for Women, taking the place of Dr. Wm. H. Weston, who recently resigned.

Mr. Paul C. Graff has been appointed instructor in botany at the University of Montana.

DISCUSSION AND CORRESPONDENCE

FURTHER EVIDENCE BEARING ON THE AGE OF THE RED BEDS IN THE RIO GRANDE VALLEY, NEW MEXICO

The almost total lack of invertebrate fossils in the Red Beds exposed on the eastern side of the Rio Grande Valley has made it very difficult to determine their exact position in the geologic column. In some localities definite determinations have been made, largely upon stratigraphic evidence, showing that the red sandstones and shales occur at horizons ranging from the Upper Pennsylvanian to the Cretaceous. The work upon this region has been reviewed by Lee and Girty.[1]

During the last summer, while engaged in a survey of the Permo-Carboniferous boundary line for the Carnegie Institution, the writer was able to spend a short time in the Red Beds near Socorro, New Mexico. The examination was made possible by suggestions and maps furnished through the kindness of Dr. N. H. Darton, of the U. S. Geological Survey.

Two or three miles north of Carthage, New Mexico, the prominent ridge of Dakota sandstone is underlain by a series of shales and sandstone varying in color from bright green to brilliant red with a few patches of conglomerate and impure limestone of limited horizontal extent. The arid valley between the ridge and the hills to the north capped by the San Andreas limestone affords an excellent exposure of the beds.

Lee and Girty reported a few doubtful invertebrate fossils from the San Andreas at this place and speak of 200 feet of red beds overlying the limestone at the old lime kiln near Carthage.

No fossils were found in these upper beds and their age is a matter of conjecture.

They also report the Abo and Yeso formations as present, but the exact locality of their section is not given. The red beds above the San Andreas limestone are faulted down against it just at the old lime kiln and can be traced up the valley for several miles. Close to the lime kiln and about half way up to the base of the Cretaceous the writer found a small bed of conglomerate containing an abundance of lamellibranchs in a very small patch. These have not yet been identified.

A few fragments of bone were found in the same bed and further up the valley, but at a lower level, other fragments were found. The following list shows them, and the containing beds, to be clearly Triassic.

1. A small section, about four inches, of the snout of a slender-jawed Phytosaur, suggesting *Angistorhinus* or *Mystriosuchus,* with teeth diverging at an angle of 15 to 20°. This was found in a concretion in a dark brown, impure limestone occurring as a lens in the red shale.

2. Three vertebræ, found at different localities, apparently Phytosaurian.

3. The proximal and distal ends of a large limb bone, badly worn and unidentified, but certainly not related to any of the known forms of Permo-Carboniferous vertebrates.

4. Two small dorsal plates. One with a median dorsal ridge and the other, regularly hexagonal and with a ventral rugosity evidently for attachment to the dorsal spine of a vertebra.

5. Several imperfect ends of large limb bones; two suggesting the ends of a tibia and a radius respectively.

6. Two fragments of thoracic plates. One

[1] Lee, W. T., and Girty, Geo. H., "The Manzano Group of the Rio Grande Valley, New Mexico," Bulletin 389, U. S. Geological Survey, 1909.

from a large plate with deep radial flutings and the other, smaller, with similar markings. Both are evidently Stegocephalian.

7. A large vertebral centrum, evidently from a sterospondylus Stegocephalian.

Most of the bones were found in the conglomerate beds, but a few in lenses of impure limestone.

Lee and Girty also give a description of the beds near the Mesa del Yeso on the eastern side of the Valle del Ojo de la Parida and report typical Manzano fossils from the Yeso formation.

The Red Beds were examined by the writer near the Ojo de la Parida about ten miles northeast of Socorro, where the Abo, Yeso and San Andreas formations are easily recognized. In the Yeso and the upper part of the Abo no vertebrate fossils were found, but in the lower part of the beds near the mouth of the Canyoncito Colorado (see the Socorro topographic sheet) beds of dark red pebble conglomerate were found lying upon green, blue and drab shales which show in the bed of the arroyo. In this conglomerate were found typical Permo-Carboniferous bones such as were collected by Dr. Williston and the writer in Rio Arribo County, New Mexico. The following list shows the similarity:

1. A complete femur of *Eryops* sp.
2. The distal end of a clavicle of *Eryops* sp.
3. The distal end of a neural spine of *Eryops* sp.
4. A femur of *Sphenacodon*.
5. A fragment of the jaw with four teeth of *Sphenacodon*.
6. The distal end of the scapula of a *Sphenacodon* or *Ophiacodon*.
7. The distal end of a large scapula, possibly *Sphenacodon*.
8. Fragments of a large pelvis, possibly *Sphenacodon*.
9. In the bluish shale in the bank of arroyo, the proximal end of a rib of diadectid type associated with poorly preserved plant remains.
10. In the drab shale below the blue, several invertebrates.

The discovery of this fauna below the San Andreas limestone adds one more bit of evidence to those already cited by the author elsewhere, for the very early appearance of specialized reptilian life in North America.

E. C. CASE

THE SWEET POTATO "SOIL ROT" OR "POX" ORGANISM[1]

SINCE Halstead in 1891 published his results on the study of "Soil Rot" of sweet potatoes, which he credited to a fungus "*Acrocystis batatas*," little positive work seems to have been done on the causative organism. During the present season observations by the author of slimy masses on the surface of roots developing large shallow "pox" marks, led to the discovery that the disease is due to a plasmodium and that there are two modes of infection. One is by the plasmodium as a whole, causing large shallow pits; the second is by means of swarm spores, which enter the growing-points of stems or roots and cause the formation of deep circular pits, when the infection reaches the main root. The swarm spores first entering a growing-point go through a rapid development in the outer host cells, passing through an ameboid and a plasmodial stage. During the plasmodial stage a large number of nuclei are formed by mitotic division. The plasmodium then forms a heavy-walled cyst in which hundreds of spores are developed. The swarm spores are liberated within the cyst, which breaks down and releases the spores, when a further infection of host cells occurs. The infection spreads rapidly to the main root, causing a pit or "pox" scar. When the pit has reached the limit of its development the plasmodium assembles and breaks out, migrating into the soil. A secondary infection by swarm spores in small immature pits, causing extensive blister-like elevations in the skin of stored sweet potatoes, has been observed. White potatoes are also subject to the disease.

The formation of a heavy-walled cyst containing several hundred swarm spores separates this plasmodium from the now-recognized genera of the Plasmodiophorales. Accordingly, the name *Cystospora batata* gen.

[1] A preliminary note.

nov., sp. nov. is proposed for this new organism. A more complete description of the organism and the histology of the disease will be published shortly. John A. Elliott

Delaware College Experiment Station,
September 18, 1916

THE SYNCHRONAL FLASHING OF FIREFLIES

In Science for February 4, 1916, E. S. Morse, under the title, "Fireflies Flashing in Unison," mentions having seen fifty years before a striking instance of the synchronal flashing of fireflies. Morse again discusses briefly the same subject in Science for September 15, 1916. He states that he has never since observed this phenomenon in the flashing of these insects. McDermott, in Science for October 27, 1916, also discusses the question of fireflies flashing in unison.

The synchronal flashing of fireflies appears to be a very rare phenomenon in North America. So rarely does it seem to occur that one may consider himself fortunate if he has observed the phenomenon even once in a lifetime. The writer about twelve years ago observed a most remarkable instance of the simultaneous flashing of fireflies in Oxford, Mass. On the night this phenomenon occurred a heavy thunderstorm had recently passed over, followed by a profound calm. From time to time dazzling flashes of lightning illuminated the landscape. The air was very warm and humid, and fireflies became unusually abundant and active, especially in a low field adjoining some woods. Here thousands of these insects were sailing low over the ground, flashing incessantly as far as the eye could see. After a while a most remarkable synchronism in the flashing appeared to take place. From time to time, as if moved by a common impulse, great numbers would flash so closely in unison over the entire field that an extensive sheet of tiny light-points would gleam upon the vision for a moment—and then vanish. This remarkable synchronism in the flashing sometimes continued several times in succession, giving one the impression of alternate waves of illumination and darkness in the distance. At times the rhythmic impulse ceased for a considerable period over the entire field. At other times it appeared to take place only in large groups occupying particular areas of the field. Although the writer has given a great deal of attention to the flashing of fireflies during the last twelve years, synchronism in the flashing of these insects has never since been observed. Depending more or less upon atmospheric conditions, fireflies show considerable variation in the character of their flight and the flashing impulse. At times the insects seem loath to leave the low herbage. On certain evenings they appear to confine their flight over the fields largely to the lowermost stratum of the atmosphere; at other times they rise upward in myriads from the grass early in the evening and drift away in all directions toward the crowns of the trees. At such times the upward flight is frequently accompanied by a weak, prolonged emission of light so that the insects appear to be tiny, glowing sparks propelled upward by gentle air currents.

H. A. Allard

Washington, D. C.

QUOTATIONS

THE NEWCASTLE MEETING OF THE BRITISH ASSOCIATION

For the third time the British Association has held its annual meeting during the great war. There are some obvious reasons for suspending such meetings, to which brief reference has already been made on the previous occasions, and to which has been since added the further restriction of available members by the adoption of universal service. But there are also good reasons for "carrying on," the best of them being provided by experience. The meetings have been eminently successful, if success is properly gauged with due account taken of the difficulties. In using the word it is not implied that the numbers present were large compared with the average numbers in peace time: at Newcastle the tickets sold were indisputably below that average—even much below it: we must think rather of what might have been, under the deplorable circumstances. The sections might have been empty, whereas they were well attended, in

some cases specially well attended even by any standard. It is a fair inference that many of the absentees were such as do not usually attend the section, preferring the lighter entertainments of the meeting. At Newcastle there were no general excursions, though the anthropologists made a sectional excursion to the Roman Wall; and there were no entertainments beyond a thoroughly enjoyable reception by the Lord Mayor on one evening, and a very pleasant garden party given by Miss Noble and Mrs. Cochrane. There is no need to determine now whether the severe economy in general gatherings need be permanent: in our present mood we naturally regard their more frivolous characteristics with disfavor. But such general gatherings, where those usually separated in calling and locality may meet for interchange of ideas, have an undoubted value which may be trusted to reassert itself when the time comes. At present we have neither much inclination nor much time for them, seeing that the whole meetings have been reduced in length.

Further, in estimating the success of the meeting, we must remember the actual difficulties to be overcome, especially by the city of Newcastle, and all who worked so devotedly in its interests. The invitation was given before the war, and it would have been quite reasonable to withdraw it under the entirely unforeseen conditions, even in the interests of the guests themselves, who might not have cared to visit an east coast "fortified town" just now. But in March last, after the necessary limitations and modifications had been frankly stated, and a courteous enquiry had been made and answered, the invitation was cordially confirmed; and from that moment no more was said of the heavy load of anxiety which those responsible for the success of the meeting must have carried with them continuously until the concluding words were spoken. —From an Oxford Note-book in *The Observatory*.

THE STATE COLLEGE OF AGRICULTURE AT CORNELL UNIVERSITY

THAT the State College of Agriculture at Cornell University is successfully solving the great problem of agricultural education is visibly evident from the fact that in a dozen years the enrollment of students in the college has increased ten-fold. Already the college of agriculture is the largest college in Cornell University, and the authorities and friends of the university share the hopes of the faculty of agriculture for a continued increase in the attendance and steady improvement and growing success in its work.

The motive force behind this great movement for a more satisfying country life and a better agriculture is the conviction that properly trained men and women must be placed on the farms and in the rural communities. Education and science are the hope of the farmers as they have already proved the boon of manufacturers and transporters. Men and women of vision and well-disciplined minds are the prime agents in accomplishing progress in every field of human activity whether intellectual, economic or material.

Under the terms of the Smith-Lever Bill New York state will in 1923, and annually thereafter, when the appropriations provided for will have reached their maximum, receive from the federal government $170,000 on condition that the state of New York provide an equal amount for cooperative extension work among the farmers of the state. Cornell University being the federal land grant college of New York is the agent by which this extension work is to be carried on.

While the federal government has thus generously encouraged education and investigation in agriculture and the extension of the results of scientific investigation to farmers on their own farms, many of the state governments have shown no less zeal for the betterment of the farmers and the improvement of conditions of farming within their own borders. Among these states New York stands conspicuous. The State College of Agriculture and Veterinary Medicine at Cornell University as well as the state experiment station at Geneva are visible evidences of the wisdom with which, in this respect, the state has been governed.

Briefly and broadly expressed, the State

College of Agriculture at Cornell University exists for the benefit of the farmers. It is a college of *agriculture,* it is not an institution of general education.

The New York State College of Agriculture has stood in the forefront among the agricultural colleges of America. Its work, however, has only just begun and vast possibilities are opening up for the future. The extent to which the college can realize these possibilities and the rate at which it can continue to progress will depend largely on how adequately its growing needs are met by appropriations from the state of New York.—President J. G. Schurman in his Annual Report.

SCIENTIFIC BOOKS

Catalogue of the Fresh-water Fishes of Africa in the British Museum. Vol. IV. By G. A. Boulenger. London, British Museum (Natural History).

The fourth volume completes the account of the fresh-water fishes of Africa, based on a collection of over 15,000 specimens, and including 1,425 species. In addition to the enormous collection of the British Museum, on which the work is primarily based, the author examined many specimens belonging to other museums, and did everything possible to make a complete survey of the subject on the lines laid down. Like other British Museum "Catalogues," this is in reality a monographic revision of the whole group of animals discussed.

When noticing a former volume, we had occasion to refer to the magnitude and importance of Mr. Boulenger's labors in this field. It may perhaps be opportune to call attention to the extraordinary value of such a worker to any museum or country. We are not only amazed at the amount of work which may be accomplished by a single man, but we observe how he secures the cooperation of collectors, men who can not themselves do technical work in zoology, but are more than glad to furnish materials to those who can make such good use of them. Collecting in tropical Africa is always difficult and often hazardous, but many enthusiasts have searched the rivers and lakes of that continent for Mr. Boulenger, proud to be partners in so great an undertaking. The aid thus rendered has been fully and exactly recognized in publication, following the excellent methods long ago established by the British Museum. In our own National Museum the staff in certain departments has always been inadequate, while the possibilities of development have never been appreciated by Congress. Curatorial work on the collections is, of course, the first necessity; but it is not realized that it would be a splendid investment to secure experts to take charge of those divisions of zoology and botany which have been least developed, and which superficially appear to stand least in need of attention. The Museum, employing one man, really secures the services of many, who become collaborators and contributors of specimens from all over the world. In 1870, only 255 species of fresh-water fishes were known from Africa; who could have guessed what intensive work would bring forth? The materials gathered together can not be sold; it is impossible to accurately define their value in money, but it ought to be sufficiently apparent that the work pays, whether we regard the tangible or intangible results.

The volume under review begins with the Carangidæ, and includes the more specialized or higher families of fishes. More than half, however, is occupied with "Addenda," descriptions of the numerous species discovered during the publication of the work. The additional species belong mainly to the Cyprinidæ, Siluridæ and Characinidæ, as might have been expected. The already enormous genus *Barbus* receives very many additions. The plan of the work does not permit any reference to the proposals by C. Tate Regan and others to break up the so-called family Characinidæ; nor does it allow the inclusion of those illuminating discussions of the geographical distribution of the various families which the author himself has published elsewhere. Although scales are used continually in the keys and descriptions, there is no reference to the microscopical characters they present and no word or line indicates that they have ever received anything but the most superficial at-

tention. This is not a matter of lack of space; it results from rigidly following a predetermined plan, and ignoring everything which does not fall within the artificially limited scope of the enquiry. It was the same attitude which caused Sir Geo. F. Hampson, in the great catalogue of moths published by the British Museum, to refuse to recognize or mention the genitalic characters of the segregates of *Apamea nictitans,* although the facts, accompanied by prepared slides, were freely offered for his use. This extreme rigidity of method has certain advantages; it permits consistency of treatment, and allows the author to base the whole classification on characters which he thoroughly understands and is accustomed to use. It may also be urged with reason that it is impossible to study or describe *all* the structures of animals, and consequently it is necessary to make a selection. Still another argument may be based on the fact which modern comparative morphology is daily making more apparent, that the minute study of almost any important structure in a long series of species will afford a fairly sound basis for classification. Thus Dr. Asa C. Chandler, in his remarkable account of the microscopical features of feathers, lately published by the University of California, shows that if we possessed *only* feathers, the birds otherwise being wholly unknown to us, we could construct from them a rational classification of the class Aves. Similarly, Dr. Edna Mosher, in a study of the Lepidopterous pupa published this year by the Illinois State Laboratory of Natural History, is able to construct a classification of moths and butterflies on the pupæ alone. It is noteworthy, however, that while the feathers of birds and the pupæ of moths essentially confirm existing systems of classification, they afford some discordant facts, which at least suggest the propriety of certain modifications. Precisely the same thing is true of the scales of fishes. The development of organs and characters in animals does not present an even front; evolution within the limits of the organism is unequal in degree and rapidity, and hence each set of structures teaches some lessons which the others do not supply. No single worker, dealing with a large group, can take the time to search for all these illuminating footnotes to the book of nature. It is the work of the comparative morphologist to uncover them; and while the professional taxonomist may properly express an opinion whether in this or that case they are significant for his purposes, he can not safely look the other way, pretending that they do not exist.

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J. L. Pagel's Einführung in die Geschichte der Medizin in 25 akademischen Vorlesungen. Zweite Auflage. Durchgesehen, teilweise umgearbeitet und auf den heutigen Stand gebracht von KARL SUDHOFF in Leipzig. Berlin, 1915, in 8°. Verlag von S. Karger, pp. i–xv + 1–616.

Within the past twenty years there has been developed, especially in Germany, an interesting subject—the history of medicine. There has been great progress in the development of this subject in all of its phases and much light has been thrown on many new lines of intellectual endeavor. There are two journals which are devoted exclusively to the history of medicine and related subjects. These are: "*Archiv für die Geschichte der Medizin,*" edited by Karl Sudhoff, in Leipzig, of which eight volumes have appeared, and the "*Zoologische Annalen, Geschichte der Zoologie,*" edited by Max Braun, 1905 to date, of which likewise eight volumes have appeared.

The two men involved in the production of the book the title of which is given above have been largely concerned in the development of the history of medicine, together with their co-workers Puschmann, Neuburger, Töply, M. Holl and others. It is an important event when the editor of the "*Archiv für die Geschichte der Medizin*" issues a second edition of Pagel's *Einführung.* After a lapse of seventeen years this important work is issued in a second edition, which is increased in scope and brought down to date by Karl Sudhoff. The work was first issued by Pagel in 1898 as Part I. of a two-volume work; the second part being: "*Historisch-medicinische Bibliographie*

für die Jahre 1875–1895." This later part has not been included in the new edition.

In regard to the scope of the work, Sudhoff, in the preface to the second edition, says: "Dass ich persönlich unter 'Geschichte der Medizin' etwas mehr verstehe als eine medizinische Literaturgeschichte: eine kulturgeschichtliche Erfassung der heilenden Kunst und Wissenschaft im Gesamtleben der Zeiten, dürfte bekannt sein, kommt aber hier nicht in Frage, wo es sich um eine 'Einführung,' um ein Lehrbuch der Medizingeschichte handelt."

Pagel, likewise, has a broad idea of the importance of the history of medicine, for he says: "Die ganze moderne Medizin baut sich auf dem Gedanken der Entwicklung auf."

As the title indicates, the volume was based originally on a series of lectures, more or less popular in nature, but all of them readable. The lectures are a little more thorough in their content than those of Ernst Schwalbe[1] and the additions made by Karl Sudhoff raises it out of the ranks of a volume of lectures and forms the greater part of my excuse for reviewing the work in this place.

The work proceeds along well-defined and usual lines, taking up serially the development of medicine in the various countries. There is nothing new or startling in the method of their presentation, but the facts are essentially all there and the addenda and references by the editor make the book a most useful one for the beginning student.

The first lecture deals with the beginnings of the healing art and discusses the nature of medical work in ancient and modern China and Japan and among the Aztecs of Mexico. The second lecture discusses medical history among the peoples of ancient India, Babylonia, Egypt, Palestine and the other countries of Asia Minor. The succeeding four lectures are devoted to the medical lore of the Greeks, with one entire chapter given to Galen.

The lectures from this point take up the development of modern medicine, and the later lectures are given a more biographical cast as various eminent men exerted an influence over various phases of medical work. Interpolated throughout these pages there is given by Sudhoff, in a way to be found nowhere else, the sources of information, recent developments of each special topic and recent literature, but not in such abundance as to be tiresome to the general reader. So that in addition to being a volume of very readable lectures it may also be used as a work of reference of no small importance, though of course not attempting to rank with the Handbücher of Pagel and Häser. It will appeal to the general reader as being free from a number of technicalities and will be found to be one of the best one-volume presentations of medical history of recent years.

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1 "Vorlesungen ueber Geschichte der Medizin," Jena, 1909.

THE ZERO AND PRINCIPLE OF LOCAL VALUE USED BY THE MAYA OF CENTRAL AMERICA

Historians of mathematics refer to the vigesimal system of the Maya[1] of Central America and southern Mexico, but, to my knowledge, no historian conveys the information that the Maya, in the writing of numbers, employed symbols for zero and the principle of local value. Added interest attaches to this matter from the fact that the Maya appear to have done this earlier than any one else. My attention is called to this achievement of the Maya by a recent book issued by the Government Printing Office in Washington, entitled *An Introduction to the Study of the Maya Hieroglyphs,* by Sylvanus Griswold Morley, 1915. This publication constitutes Bulletin 57 of the Bureau of American Ethnology. Nearly all the information contained in this article is drawn from that source.

The age of the Maya inscriptions and codices is a matter of vital interest and, as yet, of considerable doubt. It is known that

1 See, for instance, M. Cantor, "Geschichte der Mathematik," Vol. I., 3d ed., 1907, p. 9.

all dated monuments had their origin within 400 years of each other. The Maya had an accurate system of chronology, but the difficulty lies in establishing a correlation between their chronology and our own. Authorities differ on this point. Take one of the monuments, called Stela 9, in the ancient town of Copan in Honduras. Mr. Morley summarizes the various conclusions regarding the date for Stela 9 thus:[2]

> Professor Seler's date of 1255 B.C. for this is by far the oldest; Mr. Bowditch's date, A.D. 34, comes next. My own correlation assigns a date to this monument somewhere between the years 284 to 304 A.D., which an assumption made by both Mr. Bowditch and Professor Seler in their correlations would narrow to A.D. 294. Finally, the passage from The Book of Chilan Balam of Mani, as I have amended it, gives the date of this monument as A.D. 282.

The Ethnologist-in-Charge, F. W. Hodge, in his "Letter of Transmittal" of Morley's book expresses himself thus:

> The earliest inscriptions now extant probably date from about the beginning of the Christian era, but such is the complexity of the glyphs and subject-matter even at this early period, that in order to estimate the age of the system it is necessary to postulate a far greater antiquity for its origin.

For purposes of comparison, let us recall the dates of the number systems of the Babylonians and Hindus. The early Babylonians possessed the principle of local value, but, so far as now known, did not possess a zero. About two centuries B.C. they did have a zero-symbol, which was "not used in calculation, nor does it always occur when units of any order are lacking."[3] They did not employ it systematically in writing numbers and not at all in performing computations. The Hindus certainly did not use their zero-symbol systematically in their decimal number-system before probably the sixth century A.D.; the earliest undoubted occurrence of our zero in India is A.D. 876. Mr. G. R. Kaye[4] mentions A.D. 595 and A.D. 662 as dates when, as claimed by some, Indian figures were known; "on the other hand it is held that there is no sound evidence of the employment in India of a place-value system earlier than about the ninth century."

In view of this, special interest attaches to the occurrence of zero-symbols and the principle of local value among the inhabitants of the flat lands of Central America, at a period as early as the beginning of the Christian era, if not much earlier. It would seem that in this invention, the Maya in Central America possessed priority over the Asiatic peoples by a margin of five or six centuries.

The Maya number system is remarkable for the extent of its early development. Records of Maya calendars and chronology are numerous and have been successfully deciphered. In fact, "it must be admitted that very little progress has been made in deciphering the Maya glyphs except those relating to the calendar and chronology; that is, the signs for the various time periods (days and months), the numerals, and a few name-glyphs; however, as these known signs comprise possibly two fifths of all the glyphs, it is clear that the general tenor of the Maya inscriptions is no longer concealed from us."[5] As far as known, the Maya used their numeral systems only in the counting of time, as it arose in their calendar, ritual and astronomy. Many numbers that are found in inscriptions and codices occur in connection with signs, the meanings of which have not yet been ascertained. Hence, after the meanings of more glyphs are deciphered, it may be found that the numeral system had much wider application than is evident at present.

Of the several Maya numeral notations we briefly describe the one which is of greatest interest to mathematicians on account of its embodying the principle of local value and the use of symbols for zero. It is found in Maya codices, but not in their inscriptions. The

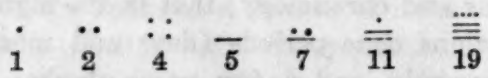
[2] S. G. Morley, "The Correlation of Maya and Christian Chronology," *American Journal of Archæology*, Vol. 14, 1910, p. 204.

[3] D. E. Smith and L. C. Karpinski, "Hindu-Arabic Numerals," 1911, p. 51.

[4] G. R. Kaye, "Indian Mathematics," Calcutta and Simla, 1915, p. 31.

[5] S. G. Morley, *op. cit.*, p. iv.

ratio of increase of successive units in this and the other fully developed Maya systems was not 10, as in the Hindu-Arabic system; it was 20 in all positions except the third. That is, 20 units of the lowest order (*kins,* or days) make one unit of the next higher order (*uinal,* or 20 days), 18 uinals make one unit of the third order (*tun,* or 360 days), 20 tuns make one unit of the fourth order (*katun,* or 7,200 days), 20 katuns made one unit of the fifth order (*cycle,* or 144,000 days), and finally, 20 cycles make one *great cycle* of 2,880,000 days. It has been contended by some archeologists that in Maya inscriptions, not 20, but 13, *cycles* constitute a *great cycle,* but in the Maya codices all archeologists agree that the only break in the vigesimal system lies in the relation that 18 uinals equal 1 tun. Proceeding now to the notation, as found in the codices, we find symbols 1 to 19, both inclusive, expressed by bars and dots. Each bar stands for five units, each dot for 1 unit. For instance,



The values of the bars and dots are *added* in each case. The zero, which plays a leading part in the notations found on inscriptions as well as those on codices, is represented in the codices by a symbol that looks roughly like a half-closed eye. This zero and the symbols for 1—19 in the Maya vigesimal notation correspond to the symbols 0, 1, 2, . . . 9 in our decimal notation. In writing 20, in the Maya codices, the principle of local value enters for the first time. It is expressed by a dot placed over the symbol for zero. The numerals are written, not horizontally, but vertically, the unit of lowest order or value being assigned the lowest position. Accordingly, 37 was expressed by the symbols for 17 (three bars and two dots) in the kin place and one dot, representing 20, placed above the 17, in the uinal place. The number 300 is expressed by three bars drawn above the symbol for zero ($3 \times 5 \times 20 = 300$). The largest number which can be written by the use of only two places or positions is $17 \times 20 + 19 =$ 359. To write 360, the Maya drew two zeros, one above the other, with one dot higher up, in third place. Using three places to represent *kins, uinals* and *tuns,* they could write any number not larger than 7,199. Proceeding in this way the Maya wrote numbers in very compact form. The highest number found in the codices is 12,489,781. It occurs on page 61 of what is known as the "Dresden Codex," a fiber-paper booklet that was reproduced facsimile by Professor E. Förstemann in 1880 and 1892. The symbols representing this number occupy six different places, one above the other. Proceeding from bottom up, the symbols in the six places are, respectively, one dot, three bars, two bars and three dots, two bars and four dots, one bar and one dot, four dots. Thus the numerals in the six places are, respectively, 1, 15, 13, 14, 6, 4. Applying to these the principle of local value, they represent altogether: $1 + 15 \times 20 + 13 \times 18 \times 20 + 14 \times 20 \times 18 \times 20 + 6 \times 20 \times 20 \times 18 \times 20 + 4 \times 20 \times 20 \times 20 \times 18 \times 20 = 12{,}489{,}781$. From these illustrations it is seen that the Maya used the zero and the principle of local value consistently in the writing of numbers reaching into the millions.

The second numeral notation that was fully developed and employed by the Maya is found in their inscriptions. It employs the zero, but not the principle of local value. Special glyphs are employed to designate the different units. It is as if we were to write 1203 as "1 thousand, 2 hundred, 0 tens, 3 ones." We omit a detailed description of the system. The ratios of successive orders of units are the same as in the preceding, with the exception, perhaps, of the unit of the sixth order. In this second notation, that unit may rest upon the ratio 13, instead of 20, as we stated above.

The numerals in the Maya codices appear to the present writer to disclose traces of an imperfect quinary system, as seen in the use of the bar to represent 5. Similarly it seems to the present writer that there is a trace of an imperfect decimal system in Maya numerals found in inscriptions, where 16—19 are represented by two symbols, one symbol for 10 and the other for 6, 7, 8, 9, respectively.

We shall not attempt to describe the Maya chronology. It is a complicated and highly developed system. The larger part of Morley's book is devoted to the description of it. His exposition is admirably clear. No specimens of Maya computation are extant. Maya records contain only the results of computation. It is evident that considerable reckoning is involved in Maya chronology. The Maya had a sacred year of 260 days, an official year of 360 days and a solar year of 365 + days. The fact that $360 = 18 \times 20$ seems to account for the break in the vigesimal system, making 18 (rather than 20) uinals equal to 1 tun. Apparently, the Maya found the lowest common multiple of 260 and 365, or 18,980. In their calendar 18,980 days consituted the "Calendar Round," a period of 52 years which is "the most important period of Maya chronology." Using this period, the Maya developed an elaborate system of counting time, "wherein any date of the Calendar Round could be fixed with absolute certainty within a period of 374,400 years."

FLORIAN CAJORI

COLORADO COLLEGE,
COLORADO SPRINGS, COLO.

SPECIAL ARTICLES

THE FOCUS OF THE AURORAL STREAMERS ON AUGUST 26, 1916

IN a recent number of SCIENCE[1] the remarkable auroral display of August 26 was described by Professor C. C. Nutting, as observed by him at Lake Douglas in northern Michigan. The phenomenon was reported to have been of unusual intensity and beauty. The appearance of streamers in the southern sky was particularly noted, as well as the fact that the auroral glow prevailed around the entire vault of the heavens, causing the earth to be illuminated without shadows.

This aurora was widespread because it was also seen in northern New York, in New Hampshire, in Nova Scotia, and over the Gulf of St. Lawrence. According to a letter in the current issue of SCIENCE,[2] it was observed as far south as Martha's Vineyard, Mass. In each case the characteristics so well described by Professor Nutting were observed.

It has been reported as far west as Washta, Ia., by F. S. Carrington.[3] In this case the streamers in the northeast passed to the south of the zenith, and the glow in the southern horizon reached to about 30°.

The aurora evidently extended eastward to the British Isles, because a bright display was reported by Mr. W. F. Denning at Bristol, England, from 2 to 4 A.M., August 27. The streamers were observed to an altitude of 70° in the northern sky, and moved rapidly from west to east.[4]

It was seen at Eskdalemuir, Dumfriesshire, from 9 P.M., August 26, to past midnight, accompanied by considerable disturbance of the magnets at the Kew Observatory. The magnetic storm commenced suddenly at 7:45 P.M., August 26. It was observed at Seskin, Waterford, in Ireland, from 10:05 to 10:40 P.M., August 26, the streamers in the northern sky stretching to within 20° or 30° of the zenith.[5]

The aurora was seen on the north shore of Prince Edward Island by the writer, who noted some of its interesting features; among which was the location of the apparent focus of the auroral streamers with respect to some readily identified stars. To this particular attention was paid.

GENERAL FEATURES OF THE AURORA

The writer was on a wide stretch of water and observed the beginning of the aurora, which occurred at 8:15 P.M. Atlantic time, the sky being perfectly clear. The glow at first showed dimly in the southern sky, but rapidly increased in intensity until the entire southern portion of the vault of the heavens was pierced by pale greenish lance-like streamers. Those overhead terminated in a well defined focus, southeast of the zenith, as shown in Fig. 1.

For some minutes there was no evidence whatever of an aurora to the north. Later, streamers rose in that section, and soon the

[1] N. S., Vol. XLIV., October 6, 1916.
[2] N. S., Vol. XLIV., October 20, 1916.
[3] *The Guide to Nature*, November, 1916, p. 191.
[4] *Nature*, Vol. 97, 2444, August 31, 1916.
[5] *Nature*, Vol. 98, 2447, September 21, 1916.

entire sky had the appearance of a luminous umbrella; the well defined center of which was southeast of the zenith. A short time after the commencement of the aurora a band-like corona stretched across the greater portion of the heavens from east to west through the focus, as shown in Fig. 2, and at another time a large irregular corona formed around that region of the sky.

Hampshire. In the report it was stated that the aurora covered the southern sky and that the "umbrella" effect of the streamers showed a center a short distance south of the zenith.

It was seen also by Dr. J. A. Brown, professor of physics in the Syrian Protestant College, Beirut, Syria, who was on a lake in the Adirondacks, N. Y., and who described the display to the writer as a very remarkable one.

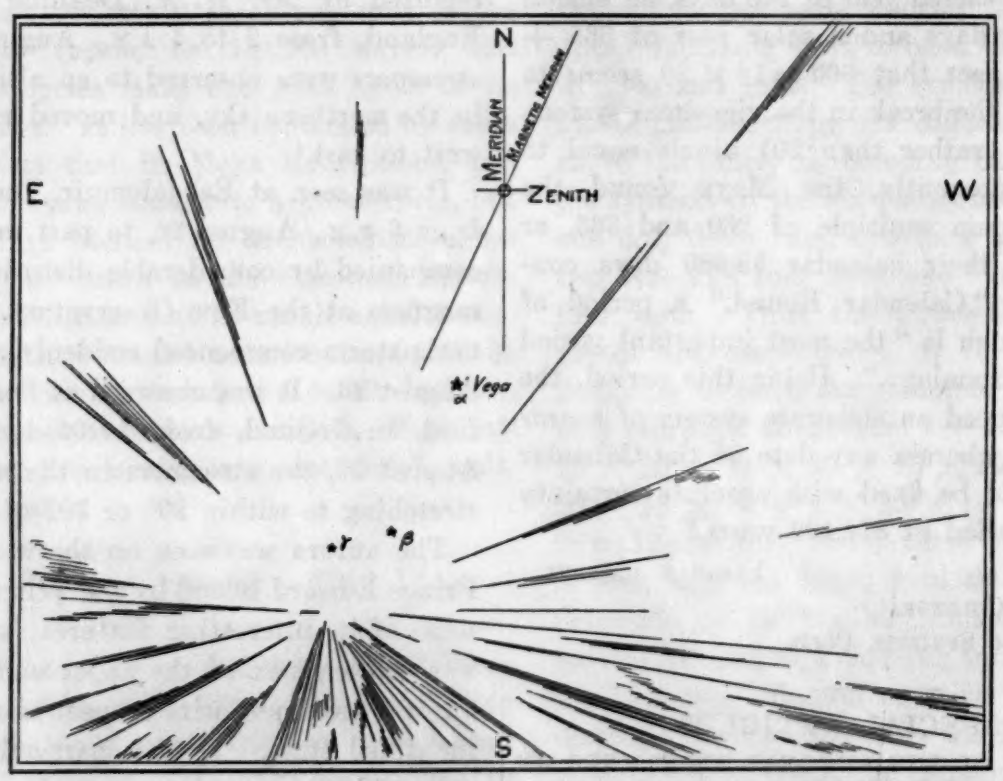


Fig. 1. Auroral focus as it appeared at 8:20 P.M., August 26, at Prince Edward Island. (*The heavens are shown as they appear when facing south and looking at the zenith.*)

The auroral glow showed the very rapid kaleidoscopic changes described by Professor Nutting and the phenomenon was indeed inspiring on account of the unusual grandeur of the display. The color of the streamers as seen from Prince Edward Island throughout the entire evening was pale greenish; almost white, and at no time reddish or the intense light green frequently observed.

The earth appeared as if illuminated by bright moonlight, except the striking effect due to the absence of all shadows, as already reported by Professor Nutting.

The aurora has been reported in a letter to the *Monthly Evening Sky Map* by Mr. Frank C. Porter, who observed it at Ashland, New

His attention was directed to the aurora with special interest on observing the streamers in the southern sky.

The occurrence of the aurora borealis in the southern half of the heavens appears to be an infrequent phenomenon; at least in the temperate zone of North America.

An aurora was observed by the writer some years ago on September 11 at Grand Lake, Maine, which completely arched the southern sky with bright streamers. That display began about eight o'clock in the evening and lasted several hours. At first, no auroral phenomenon appeared north of the zenith, but as the evening advanced a faint glow was seen in the north. Particular note was made at the

time that the streamers in the southern as well as the northern sky appeared to meet a considerable number of degrees to the southeast of the zenith, but the exact location was not observed. One fact of similarity between these two appearances of the aurora in the southern sky was that in both cases the streamers appeared in the southern half of the heavens before any indication of an aurora showed in the north; as if some condition of the atmosphere susceptible to an auroral display had been reached to the south before it has been reached to the north of the point of observation, indicating some progressive change in the atmosphere from south to north.

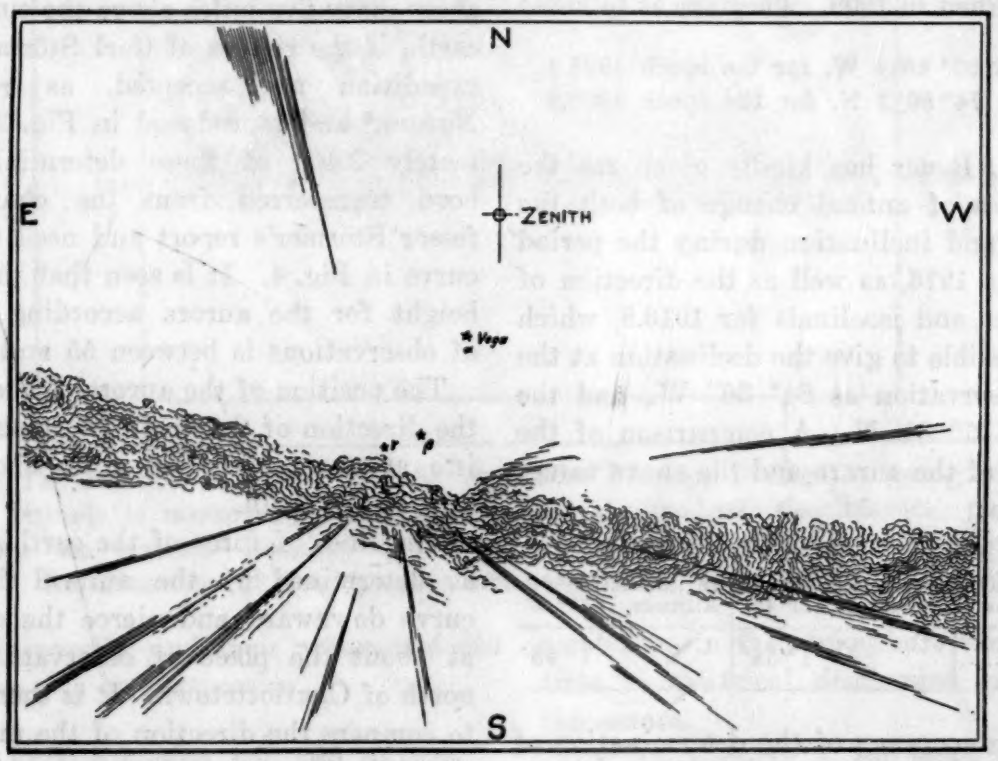


FIG. 2. Auroral corona forming a luminous band across the sky passing through the focus as observed about 8:25 P.M.

THE FOCUS OF THE STREAMERS

The position of the apparent focus of the streamers near the zenith is of special importance owing to the relation of the direction of the streamers to the direction of the lines of force of the magnetic field of the earth. The point of focus was located about two degrees south of the star γ Lyra at 8:20 o'clock Atlantic time. The time was later verified through the local telegraph office. The spot in the heavens could apparently be located within an area of the size of the full moon, which has an angular diameter of about one half degree.

Professor Nutting, describing the aurora in his article in SCIENCE, states that the "focus of the spectacle was the zenith itself." So it might appear with a casual glance, being near the zenith, and with nothing to mark that point. His paper is mainly concerned with other features of the display and is an excellent description of them, but the position among the stars toward which the streamers converged was evidently not noted.

The place of observation where the aurora was observed by the writer was about fourteen miles north of Charlottetown, Prince Edward Island, which is at latitude 46° 13′ 58.48″, longitude 63° 7′ 23.64″ according to values provided by the Department of Mines, Canada. The latitude of the place of observation is taken as 46° 26′ and longitude as 63° 8′. Mr. C. S. Brainin, of Columbia University, has kindly computed the position of the zenith with respect to the stars at the time of observation, which gives that point as shown in Fig. 1. The zenith distance of the

auroral focus thus determined is 16° 54′ and the azimuth of that point, 22° 42′ E. The accuracy of the observation, however, can not be considered better than about one degree.

It is of course desirable to compare these values with the magnetic elements of the place of observation.

The Canadian government is now engaged in making a magnetic survey, and has made observations at nearly five hundred stations in Canada, but none recently on Prince Edward Island. Fortunately, the department of terrestrial magnetism of the Carnegie Institution of Washington has been able to provide values for the magnetic declination and inclination at Charlottetown, P. E. I., which were determined in 1908. They are as follows:

Declination 23° 46′.4 W. for the epoch 1908.8
Inclination 74° 59′.3 N. for the epoch 1908.8

Dr. L. A. Bauer has kindly given me the average rates of annual change of both the declination and inclination during the period from 1908 to 1916, as well as the direction of the isogonics and isoclinals for 1916.8, which makes it possible to give the declination at the place of observation as 24° 36″ W., and the inclination 75° 04′ N. A comparison of the focus point of the aurora and the above values is as follows:

Magnetic Field / Auroral Focus	Declination, 24° 36″ / Azimuth, 22° 42′	Inclination, 75° 04′ / Altitude, 73° 06′
Difference.....	1° 54′	1° 58′

While the accuracy of the determination of the auroral focus is only one degree, it is about as close as other determinations. The observation may be unique, owing to the fact that the focus was formed by streamers in the southern as well as in the northern sky, that the point in the heavens was determined from the focus itself, and not from a corona, and at a station as far south as latitude 46°.

Elaborate observations have been made during several Arctic expeditions of the azimuth of the summits of aurora arcs, but there seems to be no definite coincidence between the azimuth measured and the magnetic meridian, the angular differences being often many degrees, sometimes as great as 20° to 40°. No explanation has been given for this anomaly. The corona center has been measured at a number of stations at high latitudes, and as a rule has been found to agree with the magnetic zenith to within about one degree.

At Cape Thorsden (78° 28′ N. Lat.) the mean of a considerable number of observations made the angle between the auroral focus and the lines of the earth's magnetism 1° 7′, the magnetic inclination being 80° 35′, while the coronal center had an altitude of 79° 55′. Somewhat smaller differences have been reported at other far northern stations.

The height of this aurora may be taken at about sixty-five miles above the surface of the earth, if the results of Carl Störmer's auroral expedition are accepted, as recorded in *Nature*,[6] and reproduced in Fig. 3. Approximately 2,400 of these determinations have been transferred from the chart in Professor Störmer's report and used to make the curve in Fig. 4. It is seen that the maximum height for the aurora according to this set of observations is between 55 and 80 miles.

The position of the auroral focus thus shows the direction of the field of terrestrial magnetism at about sixty-five miles above the surface of the earth.

The lines of force of the earth's magnetism as determined by the auroral focus should curve downward and pierce the earth's crust at about the place of observation, 14 miles north of Charlottetown. It is therefore proper to compare the direction of the magnetic field shown by the auroral streamers with the magnetic declination and inclination at that place. The observed values of both declination and inclination at 65 miles altitude are less than the values at the surface of the earth (each by about two degrees). This is exactly what should be expected since above the surface of the earth the lines of force curve towards the south pole as in the case of any magnet. Assuming the aurora to be at this height, the point on the surface of the earth directly beneath the apparent focus was about 14 miles

[6] *Nature*, Vol. 97, No. 2418, March 2, 1916.

southeast of Charlottetown and on Prince Edward Island at approximately latitude 46° 6′, longitude 62° 53′. The auroral streamers near the zenith may be regarded as approximately parallel and their apparent focus is of course due to perspective.

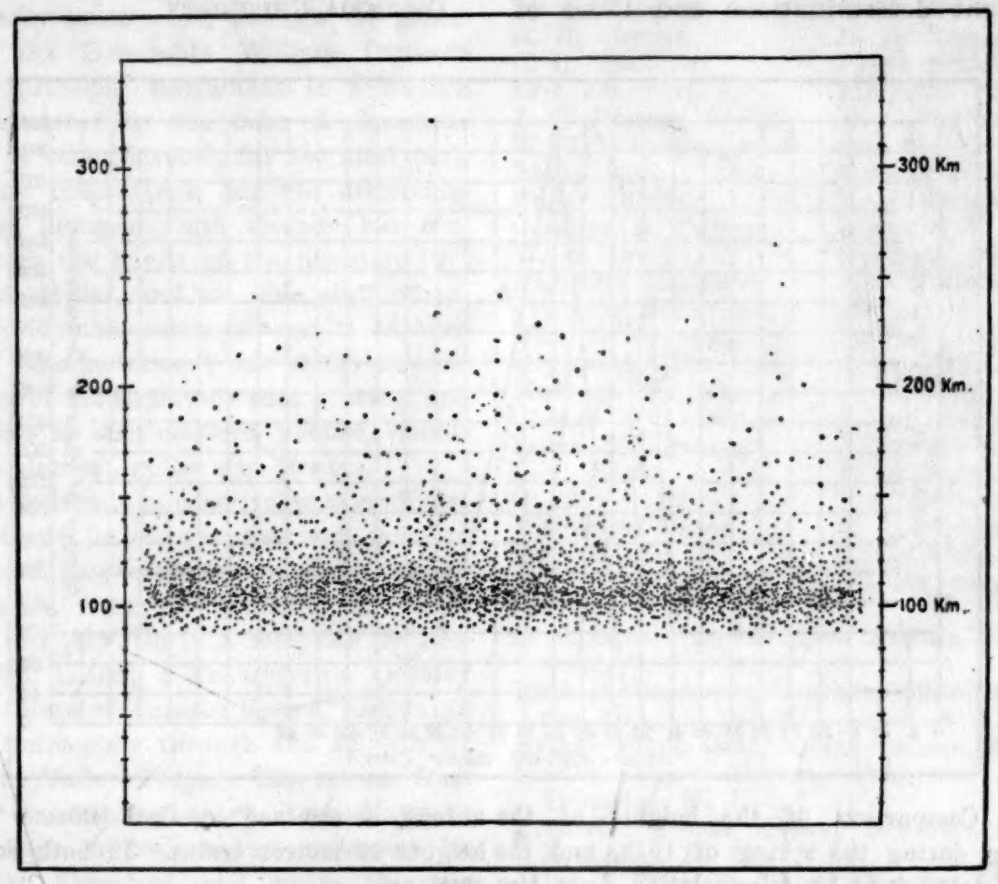


FIG. 3. The altitude of aurora borealis seen from Bossekop during the spring of 1913. Each calculated attitude is marked by a dot and the several hundred simultaneous photographs of aurora from the stations—Bossekop and Store Korsnes—(mutual distance 27½ kilometers) gave about 2,500 determinations of height, which are seen above. (Reprinted from *Nature*.)

HEIGHT OF THE AURORA AND THE METEOR TRAIN ZONE

One of the results of the study of meteor trains has been the discovery of a definite meteor train zone between 50 and 70 miles' altitude. When certain large meteors pass into this zone, a train is observed to remain in the track, apparently composed of self-luminous gas and which frequently remains visible for half an hour. Nitrogen has been found to assume a true phosphorescent state similar to the afterglow of zinc sulphide.[7] It has been observed to remain visible in the laboratory for 20 minutes. There is much evidence in favor of the view that the meteor train is phosphorescent nitrogen and formed in the same zone in the atmosphere which is susceptible to electrical discharges and results in the aurora.

In Fig. 4, curve *A*, the heights of 2,400 observations of the aurora made by Carl Störmer's expedition are shown. Curve *B* shows the heights of the middle portion of 30 meteor trains, and curve *C* gives the heights of the lower ends of 21 meteor trains.

The initial intensity of gas phosphorescence has been found to be proportional to the third power of the gas pressure;[8] hence it is to be expected that meteor trains would show a predominance at slightly lower elevation than the aurora, as indicated in Fig. 4.

[7] C. C. Trowbridge, *Phys. Review*, Vol. XXVI., June, 1908.

[8] C. C. Trowbridge, *Phys. Rev.*, Vol. XXXII., February, 1911.

It is thus evident that there is a zone in the atmosphere susceptible to electrical conductivity beginning at about 50 miles from the surface of the earth as shown by both the auroral height determinations and those of focus of the aurora of August 26 were at a height above the earth's surface not far from sixty to sixty-five miles.

C. C. Trowbridge
Columbia University

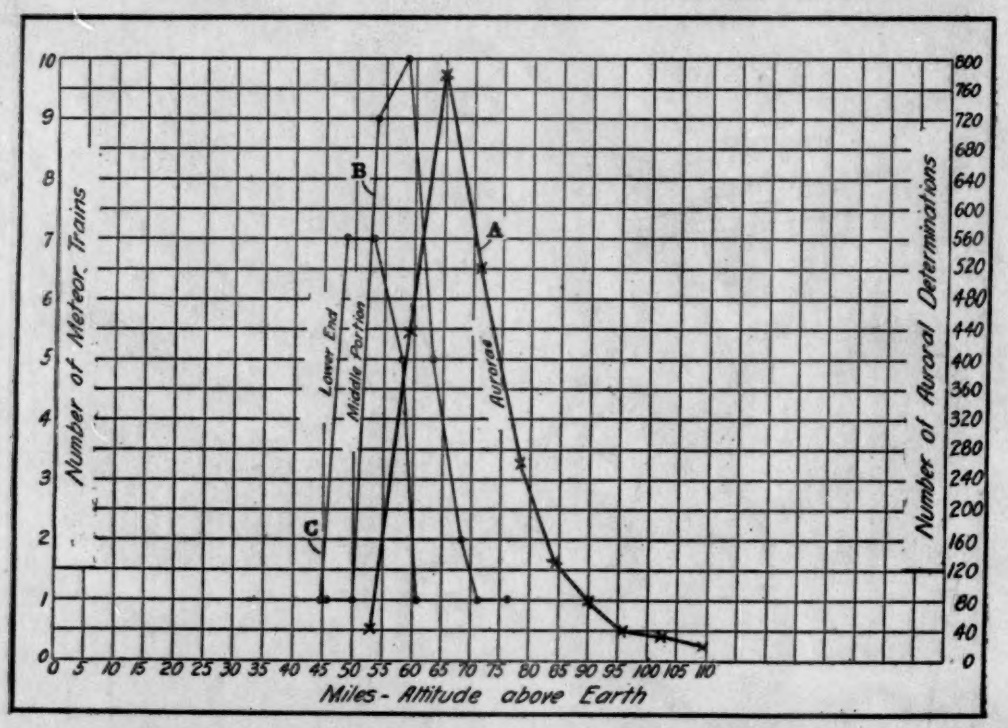


Fig. 4. Comparison of the heights of the aurora, determined by Carl Störmer's expedition at Bossekop during the spring of 1913, and the heights of meteor trains. In both cases the altitudes were determined by triangulation from two stations.

Curve *A*—2,400 determinations of the heights of the aurora.

Curve *B*—the heights of the middle portion of 30 meteor trains.

Curve *C*—the heights of the lower end of 21 meteor trains.

the meteor trains. The conducting layer in the earth's atmosphere which has been much discussed by those interested in the propagation of long electric waves is usually given as at an altitude of 35 to 40 miles by various writers on wireless telegraphy, as based on some theoretical deductions of Professor J. J. Thomson. The results given above seem to show that the main conducting layer of the atmosphere is considerably above the altitude heretofore accepted, and is at a height of from 50 to 70 miles.

The general agreement between the recently determined values of auroral heights and the altitude limits of the meteor train zone shown in Fig. 4 is very significant, and there is thus good evidence that the streamers forming the

THE NINETEENTH MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY

The nineteenth meeting of the American Astronomical Society was held in the Sproul Observatory of Swarthmore College, Swarthmore, Pennsylvania, on August 30 to September 2, 1916. This was the first meeting held east of the Allegheny Mountains since 1911, intervening meetings having been held in Pittsburgh, Cleveland, Atlanta, Evanston, and San Francisco.

It has been the policy of the society for some years past to hold its meetings at some one of the active observatories of the country. Astronomers are dependent, in a considerable measure in the nature of their contributions, on the equipment of their various observatories, and for a large part on the character and size of the telescope. It is, therefore, always of interest in the meetings to

see the observatories and instruments in detail; and by following the policy adopted the society will have eventually visited, and become directly acquainted with, the principal observatories of the country. The Observatory at Swarthmore College has been recently constructed, through the generous gift of the Honorable William Cameron Sproul. The principal instrument is a 24-inch refractor, constructed by the John A. Brashear Company. It is being devoted, for the most part, to photographic observations for the determination of stellar distances, and already has contributed, through the hands of the director, Professor John A. Miller, and his able staff of assistants, a considerable series of results of very high quality. This instrument was at the disposal of the members of the society on each evening, and we viewed with it star clusters, nebulæ, double stars, and the planets Jupiter and Uranus.

Swarthmore College is in beautiful surroundings; and the beauty of its campus was well matched by the generous hospitality extended to the society. Relaxation from the rather severe scientific program was provided in a reception by Professor and Mrs. Miller, a Pennsylvania Country Supper in the home of Senator Sproul, and in an excursion by automobile through the suburbs of Philadelphia to Valley Forge. The return from Valley Forge was made through Bryn Mawr to Haverford College, where we were welcomed by President Isaac Sharpless, and where tea was served by some of the ladies of the faculty. We visited here some of the buildings, and naturally took great interest in the well-found observatory. Continuing the ride, we arrived at dusk at the Flower Observatory of the University of Pennsylvania at Upper Darby. Here we were greeted by Provost Edgar F. Smith, Professor Eric Doolittle and his wife, and Professor C. L. Doolittle and his wife. We were the guests of the University of Pennsylvania for dinner, which was spread under the trees on the observatory grounds. Unfortunately it was cloudy in the evening, so that we were unable to have the expected opportunity of observing with the 18½-inch refractor. We did have opportunity, however, of inspecting the various instruments of this well-equipped observatory, and to see the work on double stars which Doolittle is so ably conducting. The return to Swarthmore was made late in the evening.

The following members of the society were in attendance:

Leah B. Allen,
A. T. G. Apple,
S. G. Barton,
L. A. Bauer,
A. F. Beal,
Harriet W. Bigelow,
E. W. Brown,
Annie J. Cannon,
C. A. Chant,
W. A. Cogshall,
R. H. Curtiss,
C. L. Doolittle,
Eric Doolittle,
J. C. Duncan,
W. S. Eichelberger,
Philip Fox,
Edgar Frisby,
Caroline E. Furness,
W. E. Harper,
Margaret Harwood,
François Henroteau,
Wm. T. Herriott,
Kiyotsugu Hirayama,
Mary M. Hopkins,
Charles J. Hudson,
Louise F. Jenkins,
C. C. Kiess,
O. M. Leland,
Walter A. Mátos,
Paul Merrill,
Willis I. Milham,
John A. Miller,
S. A. Mitchell,
C. P. Olivier,
Edison Pettit,
E. C. Pickering,
John H. Pitman,
John M. Poor,
A. W. Quimby,
E. D. Roe,
H. N. Russell,
Frank Schlesinger,
Frederick Slocum,
M. B. Snyder,
Joel Stebbins,
Hannah B. Steele,
H. T. Stetson,
Florence J. Stocker,
Helen M. Swartz,
John Tatlock,
Stephen D. Thaw,
Robert Trümpler,
A. B. Turner,
F. W. Very,
A. van Maanan,
J. van der Bilt,
W. R. Warner,
D. T. Wilson,
W. L. Wright,
C. C. Wylie.

New members to the society were elected as follows:

H. C. Bancroft, 412 Taylor Avenue, West Collingswood, N. J.

Ruth D. Bannister, Dearborn Observatory, Evanston, Ill.

Arthur Floyd Beal, Albion College, Albion, Mich.

Martha Clare Borton, Princeton Observatory, Princeton, N. J.

Frederick Lyons Brown, Dearborn Observatory, Evanston, Ill.

Allan B. Burbeck, North Abington, Mass.

Clifford Charles Crump, Carleton College, Northfield, Minn.

Edith Eleanor Cummings, Laws Observatory, Columbia, Mo.

Clinton Harvey Currier, Brown University, Providence, R. I.

William Ewart Glanville, St. Peter's Rectory, Solomons, Md.

Edward Gray, 2635 Channing Way, Berkeley, Calif.

William LeRoy Hart, Harvard University, Cambridge, Mass.

François Henroteau, Detroit Observatory, Ann Arbor, Mich.

William T. Herriott, Allegheny Observatory, Pittsburgh, Pa.

Kiyotsugu Hirayama, Astronomical Observatory, Tokyo, Japan.

Arthur S. King, Solar Observatory, Pasadena, Calif.

Ora Miner Leland, 150 Triphammer Road, Ithaca, N. Y.

C. B. Lindsley, 855 East Ridgeway Ave., Cincinnati, Ohio.

Walter A. Mátos, 309 College Ave., Swarthmore, Pa.

Harriet McWilliams Parsons, Vassar College, Poughkeepsie, N. Y.

Jesse Pawling, Naval Observatory, Washington, D. C.

Edison Pettit, Washburn College, Topeka, Kansas.

David B. Pickering, 81 South Burnett St., East Orange, N. J.
William Francis Rice, Wheaton College, Wheaton, Ill.
Robert Trümpler, Allegheny Observatory, Pittsburgh, Pa.
J. van der Bilt, Utrecht Observatory, Utrecht, Holland.
Reynold K. Young, Dominion Observatory, Ottawa, Canada.

At the last meeting, the election of officers took place.

President—E. C. Pickering.
First Vice-president—Frank Schlesinger.
Second Vice-president—W. W. Campbell.
Treasurer—Annie J. Cannon.
Councilors for 1916–18—E. W. Brown, J. S. Plaskett.

The following officers continue in service:

Councillors, 1915–17—Edwin B. Frost, Joel Stebbins.
Secretary—Philip Fox.

It was voted to hold a meeting of the society in conjunction with the American Association, at its coming general quadrennial meeting in New York, on December 26 to 30, 1916. Further, accepting the invitation of Professor Benjamin Boss, it was voted to hold the annual summer meeting of 1917 at the Dudley Observatory, in Albany, N. Y.

A committee composed of Messrs. W. W. Campbell, chairman; E. E. Barnard, F. B. Littell, Frank Loud, S. A. Mitchell and Edison Pettit, was appointed to further and facilitate cooperation for the observation of the coming favorable solar eclipse of June 8, 1918. The Committee on Meteors was enlarged by the appointment of C. P. Olivier, secretary; E. E. Barnard, W. J. Humphreys, F. R. Moulton and W. H. Pickering. A committee to consider instituting the grade of Associate Membership was also appointed. The members of this committee are: Messrs. Frank Schlesinger, chairman; C. A. Chant, G. C. Comstock, Philip Fox, W. T. Olcott and E. D. Roe.

Other committees of the society made reports on their work, but only one led to a motion recommending a course of action by the society. This was the Committee on Standard Equinoxes for Use in the Publication of Star Positions. The recommendation of this committee, which was adopted by the council and recommended for practise by members of the society, was "that in any publication involving star positions no equinoxes should be used intermediate between the years 1900 and 1925." If the plan of widely spaced standard equinoxes is adopted, it will greatly reduce the amount of labor now involved in the treatment of the star positions given for such a multiplicity of equinoxes.

The great European War, which has affected profoundly the whole world, has put its blighting hand on our society, in the death of Professor Karl Schwarzschild. At the last meeting of the society, the following resolution was unanimously adopted:

Whereas: In the death of Karl Schwarzschild on May 11, 1916, many of the members of this society have lost a warm friend, the society itself one of its most eminent members, and astronomy a brilliant and remarkably versatile contributor:

Resolved: That the society record in its minutes its sense of deep loss, and that copies of this resolution be engrossed and sent to Mrs. Schwarzschild, and to the Astrophysical Observatory at Potsdam.

Aside from committee reports, the scientific program consisted of fifty-two papers. The titles are given here, in the order of presentation:

1. F. Slocum: The Van Vleck Observatory.
2. E. W. Brown: The Progress of the New Lunar Tables.
3. Annie J. Cannon: Peculiar Spectra Found in Preparing the New Draper Catalogue.
4. C. P. Olivier: The Meteor System of Winnecke's Comet.
5. E. C. Pickering: Proper Motion of Stars in the Zone $-10°$ to $-14°$.
6. J. A. Miller: Summary of the Sproul Observatory Parallax Work.
7. Hannah B. Steele: The Parallax of Certain Binary Stars.
8. John H. Pitman: Choice of Comparison Stars in Parallax Determinations.
9. Philip Fox: First Results on the Dearborn Observatory Parallax Program.
10. K. Burns, W. H. Meggars, P. W. Merrill: Determination of Wave-lengths by Interference.
11. A. van Maanen: Remarks on the Motion of the Stars in $h\chi$ Persei.
12. W. S. Adams: Recent Stellar Spectroscopic Results.
13. C. J. Hudson: Irregularities in Refraction.
14. A. Hall: The New Repsold Micrometer for the 26-inch Refractor of the Naval Observatory.
15. H. L. Alden: Calibration of the McCormick Observatory Photometer Wedge.
16. S. A. Mitchell: Parallax Work at the McCormick Observatory.
17. R. H. Curtiss: The Widths of Hydrogen Emission Lines in Class B Spectra.
18. R. H. Curtiss: Some Structure Variations in Hydrogen Emission Lines in Class B Spectra.
19. H. N. Russell, Mary Fowler, Martha C. Borton: Photographic Observation of Eclipsing Variables.

20. H. Shapley: Colors of the Brightest Stars in Seven Globular Clusters.
21. H. Shapley: Notes on the Spectra of Cepheid Variables.
22. Leon Campbell: Cooperation in Variable Star Observing.
23. J. Kunz and J. Stebbins: Progress in Photoelectric Photometry.
24. F. H. Seares: The Color of the Polar Sequence Stars.
25. F. H. Seares: Distribution of Color in the Spiral Nebulæ.
26. Edison Pettit: Circumstances of the Solar Eclipse of June 8, 1918.
27. E. P. Hubble: On the Variable Nebula N. G. C. 2261.
28. F. W. Very: Lunar and Terrestrial Albedoes.
29. F. W. Very: The Spherical Albedoes of the Planets.
30. L. A. Bauer: Note on the Rotation Periods of the Planets.
31. C. C. Crump: Preliminary Note on the Spectrum of Gamma Lyræ.
32. H. N. Russell: On the Capture of Comets by Planets.
33. F. W. Very: Examination of "New Evidence" on the Solar Constant.
34. F. W. Very: Planetary Evidence in Respect to Solar Radiation.
35. F. W. Very: The Radiant Properties of the Earth from the Standpoint of Atmospheric Thermodynamics.
36. R. E. DeLury: The Effect of Haze Spectrum on Spectrographic Determination of the Solar Rotation.
37. R. E. DeLury: Note on a Supposed Variation in the Solar Rotation.
38. S. G. Barton: The Interrelations of the Asteroid Elements.
39. H. N. Russell: The Visibility of Jupiter by Daylight.
40. E. E. Barnard: A Small Star with the Largest Known Proper Motion.
41. W. W. Campbell, J. H. Moore: The Spectral Type and Radial Velocity of Barnard's Proper Motion Star.
42. F. G. Pease: Rotation and Radial Velocity of the Spiral Nebula N. G. C. 4594.
43. C. O. Lampland: Measurements of the Spiral Nebulæ N. G. C. 4254 and 5194 for Motion.
44. H. D. Curtis: Forms of Planetary Nebulæ.
45. Eric Doolittle: An Extension of Burnham's Catalogue of Double Stars.
46. J. A. Parkhurst: The Bases of Photographic Stellar Magnitudes.
47. Sarah F. Whiting: Diaries of the Tulse Hill Observatory.
48. V. M. Slipher: Spectrographic Observations of Nebulæ.
49. W. W. Campbell and J. H. Moore: Spectrographic Observations of Motion in the Planetary Nebulæ.
50. V. M. Slipher: Spectral Evidence of a Persistent Aurora.
51. C. E. St. John, Louise W. Ware: Systematic Errors in Rowland Table for Close Pairs of Solar Lines.
52. C. E. St. John: On the Mutual Repulsion of Solar Lines.

Abstracts for these papers are given in a somewhat fuller report of the meeting in the current numbers of *Popular Astronomy*, and only the main lines of the papers are commented on here. Those which pertain to details of observation are possibly sufficiently well described by the title.

It is very gratifying to hear from Professor Brown that the printing of the New Lunar Tables, computed along the lines of his complete Lunar Theory, is progressing rapidly, and that in the Ephemerides for 1923, we will, for the first time, have the results from them.

In the report by Miss Cannon on the peculiar spectra found in the observations for the new Draper Catalogue, we find that this catalogue, which is to be of immense service, also is nearing completion.

Mr. Olivier, following lines laid down by Schiaparelli, points out a new coincidence between a meteoric system and a comet's orbit.

Papers were presented by Miller, Steele, Pitman, Fox and Mitchell, dealing with stellar parallax results. Few movements in American astronomy are progressing more favorably than the campaign for extension of our knowledge of stellar distances. Many observatories are taking part in the campaign, and all are now contributing results. From the Sproul Observatory was a report on the parallax of 64 objects; the University of Virginia reported on the parallax of 96 stars; the Dearborn Observatory on 4 stars.

The paper of Mr. Adams was also of interest from the stellar parallax point of view, in that he here gives results from his very original and important spectroscopic method of estimating stellar distances.

Spectroscopists in general will be interested in the work of Burns, Meggars, and Merrill, who are extending the determinations, by interference methods, of wave-lengths of lines spaced at short intervals through the spectrum which may well be

used as standards in other determinations of wavelengths.

The fact that certain stars vary in brightness has of course long been recognized, and there are several papers here presented bearing on stellar magnitudes or on variables, by Leon Campbell, who comments on the rich and important contributions being made by associated amateurs; by Russell, who brings out some exceedingly important points from his treatment of eclipsing variables; by Shapley; by Kunz and Stebbins, who are developing their photo-electric cells; by Seares, who continues his contributions on the standard photometric field of the polar sequence; and by Parkhurst, who gives the results of his valuable experience on the bases of photographic stellar magnitudes. From various sources, important contributions are now being made, showing that the variation of light is not alone confined to the integrated light, but that marked changes of the character of the spectrum are also involved. At this meeting there were papers by Shapley, by R. H. Curtiss, by Adams, and by Miss Cannon, on this very fundamental matter.

In other directions where constancy had come to be regarded as perhaps the general condition, we are now finding marked changes. Mr. Hubble's paper on a variable nebula presented photographs of this remarkable object, showing that it had undergone astonishing change of form. Whether or not there is any relation between the change of form and the light variation of the associated star is not yet revealed. In 1914, at the Evanston meeting of the society, Slipher showed his first spectroscopic results, proving the rotation of certain nebulæ. At this meeting, he presented further evidence on the rotation of nebulæ, and contributions of similar nature were presented also by Campbell and Moore, and by Pease. Lampland gives evidence of rotation of two nebulæ from measurements of direct photographs.

It was following the presentation of Pettit's paper on the Circumstances of the Solar Eclipse of June 8, 1918, that the committee to further the cooperation in observing the eclipse was appointed.

Very's papers on the albedoes of the Moon, the Earth and the Planets, and the discussion which followed, particularly that by Mr. Russell, did much to clarify the ideas on this matter, where the results by given observers have been at variance and very perplexing.

Professor Barnard has recently found a faint star of about the eleventh photographic magnitude which, in individual proper motion, exceeds that of any heretofore recognized. In addition to Barnard's paper on this star, Campbell and Moore and also Adams contributed certain observations on its motion.

There have been very perplexing deviations in the values for the rotation of the Sun, as determined by various observers using the spectroscopic method, and also from observations made at different times by a single observer. The papers by DeLury give a sufficient and positive explanation of these deviations, and leave no reason for supposing that the rate of rotation of the Sun is variable from season to season.

In a paper on the extension of Burnham's Catalogue of Double Stars, Doolittle summarizes the work, which he has carried forward since Burnham turned over his manuscript and material to him. In doing this work, Doolittle is in a position to state at once whether any double star suspected of being new by any observer had already been noted as such. He is also in a position to state what objects have been recently and sufficiently observed, and he offers to give information on either of these points to any one who may wish to profit by such service. Double star observers, to work efficiently, must have information, at least on the latter point, and to have available the information which Doolittle has at hand will minimize the labor which its duplication would otherwise necessarily involve.

At the conclusion of the meeting, the following resolution of appreciation of courtesies was adopted:

Resolved: That the American Astronomical Society express to the President and Board of Managers of Swarthmore College, its thanks for the courtesies extended to the members of the society during the meetings at Swarthmore. The society desires also to express its appreciation of the numerous arrangements made for their comfort and convenience by Professor Miller and President Swain, and of the manner in which these have been carried out by the matron of Wharton Hall and others who have assisted in looking after the welfare of the visitors.

Resolved: That the thanks of the society be extended to Senator William Cameron Sproul, to the citizens of Swarthmore, to the president and trustees of the University of Pennsylvania, and to the president and board of managers of Haverford College for their hospitalities in connection with the visit of the society and its appreciation of the courtesies extended to its members.

Resolved: That the secretary be directed to communicate the substance of these resolutions to Presidents Swain, Smith and Sharpless, and to others who have assisted.

Philip Fox,
Secretary